EXHIBIT 5

OCS EIS/EA
BOEM 2023-054

2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program

Final Programmatic Environmental Impact Statement

SEPTEMBER 2023

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COVER SHEET

2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program
Final Programmatic Environmental Impact Statement

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Type of Action: Administrative (x) Legislative ( )

Area of Potential Impact: Offshore Marine Environment and Coastal States of Alaska, Washington, Oregon, California, Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Maine

Agency	Contact
U.S. Department of the Interior Bureau of Ocean Energy Management 45600 Woodland Road, Sterling, VA 20166	Jill Lewandowski (VAM-OEP) Bureau of Ocean Energy Management 45600 Woodland Road, Sterling, VA 20166 (703) 787-1703

ABSTRACT

This final programmatic environmental impact statement (Final Programmatic EIS) addresses development of the 2024–2029 National Outer Continental Shelf (OCS) Oil and Gas Leasing Program (2024–2029 Program). The Bureau of Ocean Energy Management (BOEM) is preparing a programmatic environmental impact statement under the National Environmental Policy Act (NEPA) because NEPA provides a well-understood framework for reviewing impacts, the 2024–2029 Program has national implications, and the program presents opportunities for tiering through subsequent NEPA analyses.

This Final Programmatic EIS addresses the purpose of and need for the Proposed Action; identifies alternatives and their screening; describes the affected environment; analyzes the potential environmental impacts of the Proposed Action and reasonable alternatives; and identifies potential mitigation measures to address potential impacts. This document analyzes potential contributions to cumulative impacts caused by oil and gas activities that may result from the 2024–2029 Program. The Final Programmatic EIS analyzes the Proposed Action—leasing in the Gulf of Mexico (GOM) Region (specifically the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area)—as well as a reasonable range of alternatives. The analyses disclose potential environmental effects of oil and natural gas leasing, exploration, development, and production on climate; coastal and offshore marine environments; and offshore marine, sociocultural, and socioeconomic resources.

This document was prepared using the best scientific information publicly available. Where relevant information on reasonably foreseeable impacts was incomplete or unavailable, the need for the information was evaluated to determine if it was essential to making a reasoned choice among the alternatives. If so, BOEM acquired the information, or, if the information was impossible or exorbitantly costly to acquire, BOEM applied accepted scientific methodologies to evaluate available credible scientific information where necessary to provide reasonable estimates for the unavailable information.

This Final Programmatic EIS and the *2024–2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program* are available on the BOEM website at www.boem.gov/National-OCS-Program/.

2.4.3 IPFs

IPFs are 2024–2029 Program activities or processes that could cause impacts on resources (**Table 2-11**). Like the stressors described above, IPFs also "stress" resources. To clearly delineate the two categories for analysis, this Final Programmatic EIS uses the term stressor only for activities not associated with the 2024–2029 Program. IPFs result specifically from 2024–2029 Program activities. IPFs are labeled with **BLUE CAPITAL LETTERS** and numbers in this document for easy identification. The potential impacts on resources from these IPFs are discussed in **Section 4.1**.

Table 2-11. General descriptions of IPFs associated with OCS oil and gas activities under the 2024–2029 Program

Note: Some of the terms used in this table are defined in the glossary (**Appendix L**). Where appropriate, the descriptions discuss associated regulations (**Appendix H**) and mitigations (**Appendix F**).

IPF or Type	Description
I.1 NOISE	See descriptions below of specific types.
Geophysical Survey Noise	There are two main types of geophysical surveys: (1) marine seismic surveys, which generally cover a large area and are deep penetration and high resolution; and (2) geohazard surveys conducted using tools such as side-scan sonars, CHIRP sub-bottom profilers, multibeam echosounders, and small airguns to detect archaeological resources or seafloor features that could be problematic for operations. Marine seismic surveys generally use airguns (stainless steel cylinders filled with pressurized air). Airguns generate a short-duration, high-amplitude signal when air is released. These acoustic impulses are emitted typically at intervals of 5–30 seconds. Airgun noise frequency ranges from 10–5,000 Hz, but most of the acoustic energy is < 500 Hz. See **Appendix B** of this document, BOEM (2014), and BOEM (2017d) for more detail.
Vessel Noise	The noise generated by vessels depends largely on vessel size and vessel speed (McKenna et al. 2013). Small vessels (e.g., crew boats, tugs) are typically quieter but emit noise that is higher in frequency (50–5,000 Hz) than larger vessels (e.g., commercial vessels, cruise ships, supertankers, icebreakers) (Jiménez-Arranz et al. 2020).
Aircraft and Helicopter Noise	Aircraft noise is caused by engine and transmission operation, as well as the movement of propellers and rotors through the air. Turbine helicopters have transmissions and gearboxes that create substantial noise (whining). Airplanes can have either piston or turbine engines in single or multi-engine configuration. This noise can be substantial in air, but penetration of aircraft noise into the water is limited because much of the noise is reflected off the water's surface (Richardson et al. 1995). Therefore, noise from passing aircraft is more localized in water than it is in air and typically is limited to frequencies < 1,000 Hz. All aircraft are expected to follow Federal Aviation Administration (FAA) guidance when flying over land, including at a minimum altitude of 2,000 ft (610 m) over noise-sensitive areas, such as national parks, national wildlife refuges, and wilderness areas (Kaulia 2004). In addition, when flying over marine mammals, aircraft follow guidelines from National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) requiring a minimum altitude of 1,000 ft (305 m) (50 CFR Ch. II § 216.124).

IPF or Type	Description
Drilling and Production Noise	Drilling noise includes mechanical noise from the drill and support equipment, as well as noise from dynamic positioning and propulsion systems. Drilling noise contains low-frequency sounds (10–10,000 Hz); positioning noise is higher in amplitude and lower in frequency (< 1,000 Hz) and can be more directional. Drilling noise can be continuous or transient, and sound levels depend on the type of drilling rig used, water depth, and how well-coupled the noise-producing equipment is to the water. Dynamically positioned drill ships generally produce the highest levels of underwater noise, followed by semi-submersibles; jack-up rigs are the quietest. Production noise is generally low frequency (< 1,000 Hz) and temporally similar to drilling (Jiménez-Arranz et al. 2020).
Pipeline Trenching Noise	Pipelines are trenched using plow and jet burial, generating continuous, transient, and variable sound levels typically 20–1,000 Hz in frequency range (Nedwell and Edwards 2004).
Construction Noise	Installing offshore platforms and associated infrastructure requires dredges, pile-driving equipment, barges, and other equipment. Most acoustic energy from pile driving falls below 1,000 Hz. Construction of onshore ports, docks, ice-bound islands, or caissons can create noise from trucks, earthmoving equipment, and more (Amaral et al. 2020).
Platform Removal (includes explosives use)	Platforms may be removed by placing explosives inside platform legs or conductors 15 to 25 ft (4.6 to 7.6 m) below the seafloor. Although the frequency range of explosive charges can be relatively broad, most of the energy is between 10–5,000 Hz (Urick 1983).
I.2 TRAFFIC	This IPF considers the physical presence of traffic and does not include **I.5 EMISSIONS** produced by these sources.
Aircraft	Helicopters transport people to and from offshore platforms. Helicopters generally maintain a minimum altitude of 700 ft (213 m) over the OCS.
Vessels	Vessels are used for a variety of oil and gas activities, from geophysical surveys in the exploration phase through infrastructure removal in the decommissioning phase. Support vessels transport supplies and crews from the shore to drilling location and look out for sea ice or marine mammals. Barges may transport drill cuttings and spent drilling muds to onshore disposal facilities. Oil spill response vessels may operate near offshore structures or near the shore in response to a spill or to conduct exercises.
Onshore Traffic	Trucks, cars, and other vehicles operate onshore to mobilize, demobilize, stage, and supply offshore activities, as well as support construction and maintenance of onshore ports and other facilities.
I.3 ROUTINE DISCHARGES	See descriptions below of specific types.
Produced Water	Produced water is the largest individual discharge produced by normal operations. Produced water is water brought to the surface from an oil-bearing formation during oil and gas extraction (Neff et al. 2011). Small amounts of oil and other chemicals are routinely discharged in produced water during OCS operations. Produced water discharges are regulated under National Pollutant Discharge Elimination System (NPDES) permits issued by the USEPA (40 CFR Part 435).
Sanitary Waste and Gray Water	Sanitary and gray water wastes are often treated and either discharged into the sea under the applicable NPDES permit or injected into oil-bearing formations to enhance oil production.

IPF or Type	Description
Well Completion and Enhanced Recovery Fluids	Fluids from well completion, well stimulation treatments (including hydraulic fracturing), and reservoir flow enhancement techniques can be discharged with produced water in accordance with NPDES permit requirements. These permits limit toxicity of all effluents and require monitoring and reporting.
Debris	Debris includes trash, tools, or equipment lost overboard, and miscellaneous components left on the seafloor after decommissioning when removal is not logistically feasible (more common in deep water). BSEE enforces marine debris requirements found in 30 CFR § 250.300.
Drilling Muds and Cuttings	Drilling muds are used to lubricate and cool drill bits and pipes and maintain well pressure to prevent loss of well control. Water-based mud is circulated down a hollow drill pipe, through the drill bit, and up the annulus between the drill pipe and the borehole. The mud also carries crushed rock produced by the drill bit to the surface, where these cuttings are removed, and the mud is then recycled back down the well. The primary components of water-based mud are fresh or saltwater, barite, clay, caustic soda, lignite, lignosulfonates, and water-soluble polymers. Both the drilling mud and the separated cuttings may be discharged to the ocean or barged for onshore disposal, depending on NPDES permit requirements. Synthetic-based mud (SBM) may also be used (Neff et al. 2000) and must be disposed of according to NPDES permit requirements.
Miscellaneous	Miscellaneous discharges from facilities and vessels include deck drainage; desalination unit brine; and uncontaminated cooling, bilge, fire, and ballast water.
I.4 BOTTOM/LAND DISTURBANCE	See descriptions below of specific types.
Drilling	Drilling disturbs the seafloor where the well infrastructure and borehole penetrate and where mud and drill cuttings are deposited. The highest cutting concentrations are usually in sediments within 328 ft (100 m) of the platform, but some cuttings may be found up to 1.2 mi (2 km) from the discharge point (Neff et al. 2000).
OCS Infrastructure Emplacement	Structure emplacement disturbs bottom habitat and temporarily increases organic material and suspended sediments in nearby water. Diverse biota, including fish and encrusting algae and invertebrates, may be attracted to the structures or colonize them.
Anchoring	Anchors, anchor chains, and cables for vessels or equipment may disturb the seafloor, re-suspend sediments, and damage habitats or cultural resources. The area and severity of impacts varies with anchor size and extent of contact between the cable and seafloor.
Pipeline Trenching	Pipeline trenching temporarily displaces and re-suspends seafloor sediments.
Onshore Construction	OCS activity may require construction of onshore infrastructure, such as ports and support facilities (repair and maintenance yards, crew services, support sectors), construction facilities (platform fabrication yards, shipyards and shipbuilding yards, pipe coating facilities and yards), transportation infrastructure (pipelines, railroads), and processing facilities (natural gas processing, natural gas storage, liquefied natural gas [LNG] facilities, refineries, petrochemical plants, waste management).
Routine Maintenance	OCS oil and gas infrastructure requires maintenance throughout its lifespan, often with the use of submersibles and other equipment. These maintenance activities may result in disturbance of the seafloor and fauna attached to the underwater infrastructure.

IPF or Type	Description
Structure Removal	OCS platforms are removed using explosives or by cutting structures below the sediment line. After the structures are severed, trawls retrieve and clean up dislodged materials, which causes seafloor disturbance and sediment displacement.
I.5 EMISSIONS	See descriptions below of specific types.
Offshore Facilities	Offshore oil and gas activities emit air pollutants. Activities that produce emissions include drilling operations, platform construction and emplacement, platform operations, and flaring. Emissions may also come from release of volatile organic compounds (VOCs) through transfers, spills, and fugitive emissions.
Onshore Facilities	Onshore oil and gas support facilities, such as heliports, seaports, and other support facilities, emit air pollutants.
Mobile Sources	Vessels, aircraft, and onshore traffic associated with offshore oil and gas activities emit air pollutants.
I.6 LIGHTING	See descriptions below of specific types.
Offshore Facilities	Platforms, drill rigs, construction equipment, vessels, and other OCS components have lights that are required for safety and effective working conditions. Navigation lights must be visible to specified distances to ensure that the facility is visible to other vessels and aircraft. Lighting is also associated with submersibles and other equipment used for underwater maintenance activities. Light is also produced by flaring, which is the burning of waste or excess gas from offshore platforms.
Onshore Facilities	Many onshore facilities have lights for safety and working conditions. These facilities include onshore infrastructure described in the onshore construction description of **I.4 BOTTOM/LAND DISTURBANCE**.
I.7 VISIBLE INFRASTRUCTURE	See descriptions below of specific types.
Offshore and Onshore Facilities	Facilities offshore and onshore may be visible to people or animals (e.g., birds). Visibility varies with distance, infrastructure height, viewer elevation, and weather conditions (e.g., fog, haze, rain).
I.8 SPACE-USE CONFLICTS	See descriptions below of specific types.
Offshore Facilities	Overlapping uses of the OCS (e.g., military and NASA activities, fishing, subsistence hunting and harvesting, and renewable energy) may cause spatial or temporal conflicts among users.
Onshore Facilities	Overlapping onshore activities (e.g., planning and siting of onshore facilities, ports, construction facilities, transportation, and processing facilities) may cause spatial or temporal conflicts among users.
ACCIDENTAL EVENTS (SECTION 4.6)	See descriptions below of specific types.
Reasonably Foreseeable Accidental and Unauthorized Events	Spills of fuel or crude oil may result from accidents, intentional discharges, weather events, and collisions.

2.7 PACIFIC REGION

Figures 3-6 and 3-7 show the Pacific Region's current conditions and future baseline conditions.

BOEM's Pacific Region includes 7,863 mi (12,654 km) of shoreline covering the Federal waters off Washington, Oregon, and California (NOAA 2016e). The region contains two BOEM ecoregions (Washington/Oregon and California Current) and four OCS planning areas (Washington/Oregon, Northern California, Central California, and Southern California) (**Figure 2-4**). Currently, there are active oil and gas leases in the Southern California Planning Area.

2.7.1 Physical Environment

The continental shelf along the Pacific Coast is relatively narrow (5–40 mi [8.1 km–24 km]) and has a steep continental slope. The seafloor in the Pacific Region has a mix of soft and hard bottom areas. Rocky subtidal habitats are not continuous in the Pacific Region but occur in areas with bedrock outcroppings, seamounts, offshore islands, and fragments of mid-ocean ridge (Garrison 2004). Examples include the Orford Reef off Oregon and Cordell Banks and Gulf of the Farallones off California (**Figure 2-10**). Dynamic major tectonic features, such as the Gorda and Juan de Fuca plates and associated ridges (**Figure 2-10**), create and affect benthic habitat throughout the region.

The ecology of the Pacific Region is primarily driven by its eastern boundary current, the California Current, and its associated undercurrent (King et al. 2011) (**Figure 2-10**). The year-round California Current is a slow, broad, southward flowing current that brings cold, nutrient-rich water from the north Pacific. Along the coast, the prevailing northwesterly winds cause upwelling where surface water is pulled offshore and is replaced by deeper, nutrient-rich, low-oxygen waters. When exposed to sunlight at the surface, these waters support high levels of primary productivity throughout the Pacific Region. The Southern California Bight is an area off southern California extending south from Point Conception, where complex current circulation patterns create a distinct change in fauna. The Channel Islands—some of which are designated as a National Marine Sanctuary (NMS)—create complex circulation patterns and provide habitat to diverse species of R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS**. Near Point Conception, a portion of the California Current turns and flows northward, joining the California Undercurrent. Lying beneath the California Undercurrent is an oxygen-minimum zone, which is a decreased oxygen layer that extends from the upper continental shelf to depths of greater than 1,000 m (3,281 ft) (Mullins et al. 1985).

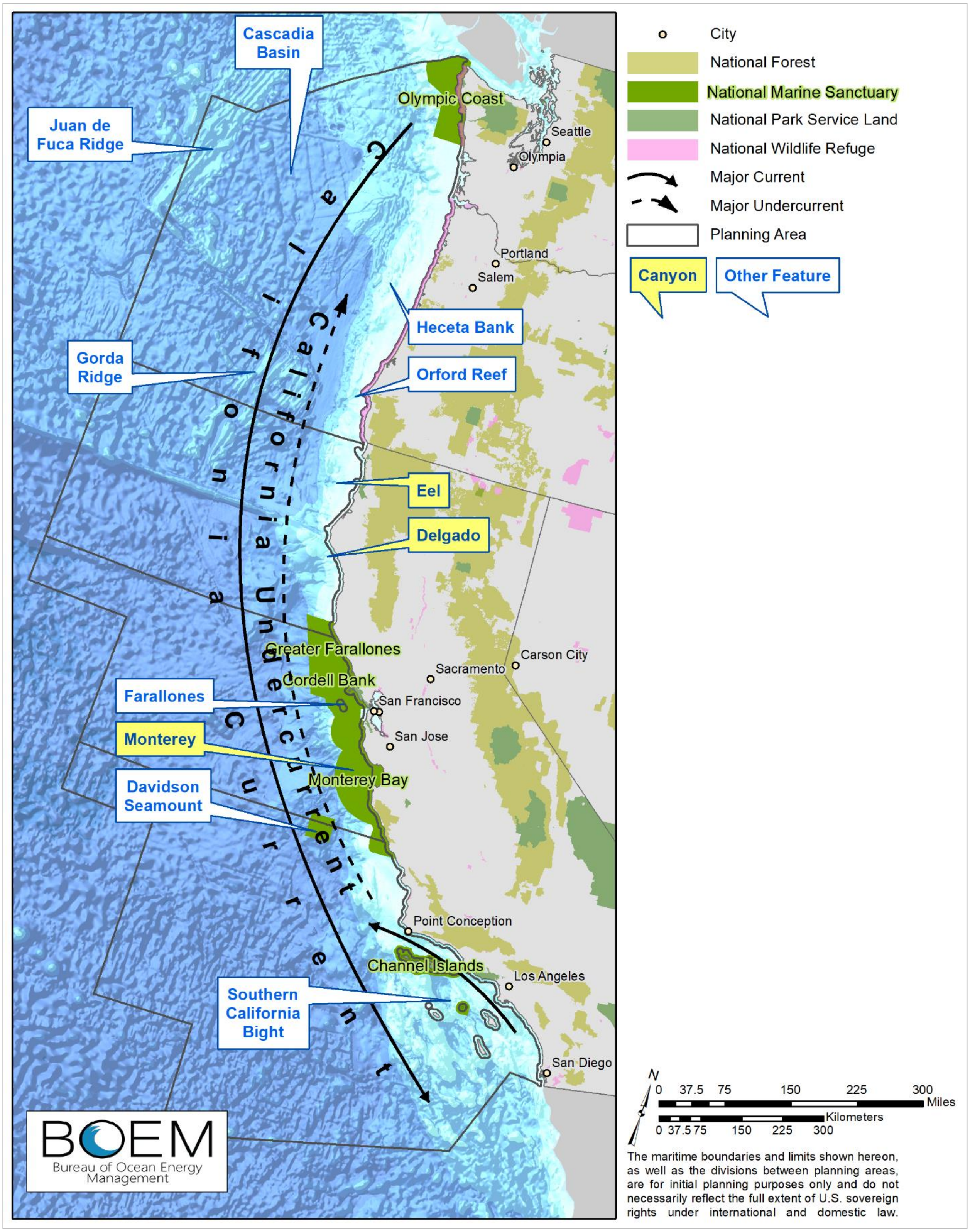


Figure 2-10. Pacific Region physical, political, and land management features

Future Baseline Conditions (Figure 3-7). R.1 **AIR QUALITY** is expected to remain degraded in the Los Angeles Metropolitan Area. California's State Implementation Plan, which describes California's framework for improving air quality, shows that, despite the state's attempts to reduce emissions from vessels and aircraft via regulations, offshore contributions from vessels to southern California nonattainment areas are expected to rise due to increased vessel traffic (California Air Resources Board 2017). Wildfire seasons have become longer and more intense due to the region's changing climate (Yoon et al. 2015), which may make it more difficult for areas adjacent to the Southern California Planning Area to reduce PM_{10} and $PM_{2.5}$ concentrations (McClure and Jaffe 2018). Air quality in areas adjacent to the Washington/Oregon, Northern California, and Central California Planning Areas is expected to improve as the existing nonattainment areas come into compliance with the CAA in the coming decades.

R.2 **WATER QUALITY** in the Pacific Region may continue to be influenced by activities such as urbanization; municipal waste discharges; agriculture; marine vessel traffic-related discharges; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military operations; offshore oil and gas activities; natural hydrocarbon seeps; and climate change. In particular, increased urbanization, vessel traffic, offshore oil and gas activities, and climate change may lead to a decrease in water quality in the future. As a result, overall water quality is expected to decline in many areas.

2.7.2 Pelagic Environment

Current Conditions (Figure 3-6). Much of the Pacific Region experiences significant upwelling of nutrient-rich cold water, leading to high levels of primary productivity, especially in the summer months (Schwing et al. 1996). Upwelling exhibits a strong seasonal pattern off central California and areas farther north, with upwelling at its maximum in the late spring and downwelling occurring in the winter (Schwing et al. 1996). During El Niño events, the upwelling forces are weaker, leading to warmer temperatures and lower nutrient content in surface waters, which decreases primary productivity (Jacox et al. 2015; King et al. 2011). Climatic variability in this region (e.g., El Niño-Southern Oscillation [ENSO]) makes it difficult to detect broader oceanographic trends. However, studies have documented an increase in the average temperature of the California Current (Di Lorenzo et al. 2005; Xiu et al. 2018), a decrease in oxygen concentrations (Hoegh-Guldberg et al. 2014), and an increase in acidity in the ocean waters (Chan et al. 2017; Osborne et al. 2019).

The distribution and abundance of R.3 **PELAGIC COMMUNITIES** in the Pacific Region are largely driven by spatial and temporal patterns of upwelling intensity and water mass variability. Zooplankton communities are dominated by copepods and krill but also include jellyfish, pteropods, and larvae of anchovy, sardine, and larger pelagic R.6 **FISH** species like Pacific hake and jack mackerel (Brodeur et al. 2008). Copepods are most abundant in the summer and form temporary aggregations near fronts where phytoplankton are concentrated and larger predators come to feed. Forage fish like anchovies, sardines, and mackerel also feed in these areas; they have R.6 **ESSENTIAL FISH HABITAT** in Pacific Region waters above the thermocline, which extends from the coastline to 200 nmi (370 km) offshore (Pacific Fishery

Management Council 2016b). Some pelagic invertebrates such as jellyfish also feed on plankton and may compete with forage fish for these resources (Brodeur et al. 2008). Monterey Canyon, the largest submarine canyon on the West Coast, is part of a designated NMS (**Figure 2-10**). The deep, nutrient-rich waters near the canyon stimulate a persistent phytoplankton bloom (Ryan et al. 2005); many species of fish, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** congregate to feed in this highly productive environment. Squid, a highly valuable R.10 **COMMERCIAL FISHERY**, are concentrated in the Central California and Southern California Planning Areas (NMFS 2018b; Pacific Fishery Management Council 2016a). Decreases in stocks of forage fish may affect entire pelagic communities because many larger predators, such as birds and marine mammals, rely on them for food.

Salmon are an example of anadromous fish, which spend part of their lives in freshwater to reproduce and grow as larvae and juveniles and are often harvested at sea (Pacific Fishery Management Council 2018). Several Pacific Region salmon stocks are overfished, including the Klamath River fall stock of Chinook and Juan de Fuca stock of coho salmon (NMFS 2018b). All OCS waters from the U.S. and Canada border to Point Conception are R.6 **ESSENTIAL FISH HABITAT** for Chinook, coho, and Puget Sound pink salmon (Pacific Fishery Management Council 2014). Other salmon species are less commonly encountered in marine fisheries. Salmon, especially the larger Chinook, feed on other fish and on marine invertebrates like copepods (Pacific Fishery Management Council 2014). Generally, salmon constitute small portions of other pelagic predators' diets, though some species (e.g., killer whales and seals) eat higher proportions of salmon, especially pink salmon (North Pacific Fishery Management Council 2014). In addition to these harvested species, ESA-listed salmon and steelhead occur in all Pacific planning areas, with higher concentrations in northern regions (NOAA 2016f).

Several species of ecologically, culturally, and commercially important anadromous R.6 **FISH** *occur in the Pacific Region*:

Chinook, chum, coho, pink, sockeye salmon

Steelhead trout

Green and white sturgeon

Larger pelagic predators in the Pacific Region include several highly migratory species such as tuna, swordfish, and sharks. The ESA-listed Eastern Pacific DPS of the scalloped hammerhead, a large pelagic shark species, occurs in continental shelf waters to depths of 3,281 ft (1,000 m) in all Pacific planning areas. The Humboldt squid is a large predatory invertebrate that spans a wide depth range and preys on species from both R.3 **PELAGIC COMMUNITIES** and R.4 **MARINE BENTHIC COMMUNITIES** (Zeidberg and Robison 2007); its range has been increasing northward in the last few decades (Stewart et al. 2014).

The Pacific Region community of R.7 **BIRDS** is large and diverse and includes far-ranging species that come from the Pacific Ocean, Bering Sea, Arctic Ocean, and inland North America. Seabirds occur year-round in both nearshore and offshore environments, but species composition varies seasonally (Adams et al. 2014; Briggs et al. 1981; Mason et al. 2007). In the northern California Current System, Adams et al. (2014) reported similar densities of seabirds in the fall and winter and lowest densities in the summer. Species composition followed a similar trend, with highest diversity in the fall and lowest in the

summer. Seabird densities were highest along the inner shelf in waters shallower than 328 ft (100 m) deep and lowest in offshore waters deeper than 656 ft (200 m) deep. Several ESA-listed species occur in the pelagic environment, including the short-tailed albatross, Hawaiian petrel, and marbled murrelet. Pelagic bird species feed in deeper waters that are farther from shore. These species spend much of their time on the water surface or diving for food. Common offshore birds include storm-petrels, albatrosses, shearwaters, fulmars, phalaropes, jaegers, and alcids.

Four ESA-listed R.8 **SEA TURTLES** feed in or pass through the waters of the Pacific Region, though there are no known turtle nesting areas along the U.S. Pacific Coast. The Western Pacific subpopulation of leatherback turtles is usually found in summer and fall off the West Coast, where they come to feed on jellyfish. This population shows continued decline (NOAA 2016d; Tiwari et al. 2013); fisheries bycatch may lead to additional mortality of leatherback turtles (Benaka et al. 2019). Critical habitat for the leatherback overlaps all Pacific planning areas but is most extensive in the Washington/Oregon Planning Area (NOAA 2016d). The East Pacific DPS of green turtles has been sighted from southern Alaska to Baja California Sur, Mexico, but the turtles are mostly found in the Southern California Planning Area (NOAA 2018). NMFS has proposed to designate critical habitat in nearshore waters (from the mean high-water line to 10 km offshore) between San Diego Bay and Mexico. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM and Atlantic Ocean (88 FR 46572).The ESA-listed North Pacific Ocean DPS loggerhead turtles and olive ridley turtles occasionally occur off California (NOAA 2014b; 2017d).

The following threatened or endangered species have critical habitat designated within BOEM planning areas in the Pacific Region (detail and map in ***Appendix D****):*

Leatherback turtle: Washington/Oregon, Northern California, Central California, Southern California

Green sturgeon (Southern DPS): Washington/Oregon, Northern California, Central California

Pacific eulachon (Southern DPS): Washington/Oregon, Northern California

Tidewater goby: Northern California, Central California, Southern California

Western snowy plover: Washington/Oregon, Northern California, Central California, Southern California

Marbled murrelet: Washington/Oregon, Northern California

R.9 **MARINE MAMMALS** are abundant in the Pacific Region; some migrate through, while others are year-round residents. Humpback and blue whales travel to the Pacific Coast to feed, and gray whales travel through nearshore waters of the region each year during their migration between Alaska and Mexico. Harbor porpoises have resident populations in waters < 131 ft (40 m) along the northern coast (NMFS 2009). Similarly, southern resident killer whales generally reside in nearshore and inland waterways along the coast in the Washington/Oregon Planning Area; NMFS is considering extending

critical habitat for this population to offshore waters of the Pacific Region up to 650 feet (200 m) deep. Additional cetaceans that occur in the Pacific Region include other baleen whales (minke, eastern North Pacific gray, sei, fin, and, rarely, Bryde's and North Pacific right whales) and several species of toothed whales, including dolphins, porpoises, beaked whales, and sperm whales (Barlow and Forney 2007; Carretta et al. 2020; Dailey et al. 1993). Eight ESA-listed marine mammal species that occur or may occur in this region are the Guadalupe fur seal and blue, fin, humpback, North Pacific right, sei, southern resident killer, and sperm whales. Resident semi-aquatic mammals of the California Current include California sea lions, Steller sea lion Eastern DPS, northern fur seals, northern elephant seals, and Pacific harbor seals (Barlow and Forney 2007; Dailey et al. 1993). These animals forage at sea and come to land to rest, give birth, and nurse their young. Marine mammals may become entangled in fishing gear and caught as bycatch by various fisheries. In 2015, approximately 92 marine mammals from 20 different stocks were reported as bycatch by U.S. fisheries, including California sea lions, dolphins, and whales (Benaka et al. 2019).

Future Baseline Conditions (Figure 3-7). Over the next 40 to 70 years, R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS** in the Pacific Region are expected to face challenges as climate change influences oceanographic conditions, fishing pressure continues, and aquaculture and vessel traffic expands.

Increased warming in the Pacific Region could impact R.3 **PELAGIC COMMUNITIES** that are highly vulnerable to changes in the intensity and mixing of currents, which affects concentrations of oxygen, carbon, and nutrients (Hoegh-Guldberg et al. 2014). However, there is considerable scientific debate about whether increasing temperatures expected from climate change will lead to higher stratification, or whether stronger winds will intensify upwelling (Auad et al. 2006; Hoegh-Guldberg et al. 2014; Xiu et al. 2018). Changes in upwelling intensity could increase nutrient availability in nearshore areas, which may increase primary production but decrease oxygen concentrations due to enhanced microbial activity (Hoegh-Guldberg et al. 2014). These changes may lead to disconnects between phytoplankton and their planktonic grazers. For example, lack of adequate food during the critical larval growth period could harm R.6 **FISH** (Bakun et al. 2015). Some species may shift northward, while other more adaptive species could thrive under the new conditions (Brodeur et al. 2019). For example, jellyfish abundance is on the rise in the California Current, which represents a growing challenge for forage fish that compete for the same prey resources (Brodeur et al. 2008). Humboldt squid are adaptable to changing temperatures and prey availability; their recent range expansion is expected to continue, which could affect pelagic fish stocks (Zeidberg and Robison 2007).

Multiple stressors present ongoing challenges to larger pelagic species in the Pacific Region, and these stressors are expected to continue in future years (Maxwell et al. 2013). R.9 **MARINE MAMMALS** are at risk of vessel collisions, especially in major shipping lanes near San Francisco and Long Beach, CA (Rockwood et al. 2017). HABs can be lethal for animals, including R.7 **BIRDS**; sea lions; sea otters; and gray, humpback, and fin whales (Cook et al. 2011; Jones et al. 2017; McCabe et al. 2016; Miller et al. 2010). Warm-water anomalies may become more common due to climate change and may exacerbate these blooms (McCabe et al. 2016; Van Dolah 2000) and affect R.2 **WATER QUALITY**. Offshore pelagic and highly migratory species—such as sharks, birds, R.8 **SEA TURTLES**, and marine mammals—

increasingly encounter active and abandoned fishing gear and plastic debris, elevating their risk of mortality through entanglement, choking, and ingestion of indigestible and toxic materials (Floren and Shugart 2017; Jepsen and de Bruyn 2019; NOAA 2020b; Schuyler et al. 2016).

2.7.3 Benthic Environment

Current Conditions (Figure 3-6). Rocky intertidal zones are home to many species of macroalgae and macroinvertebrates, including bivalves, octopus, limpets, and sea stars. Species composition varies with the level of wave and tidal exposure. Intertidal and subtidal areas along rocky coasts in the Central and Southern California Planning Areas have been designated as critical habitat for the ESA-listed black abalone.

Rocky benthic habitats in deeper waters are home to species such as sea urchins, deepwater corals and sponges, Pacific octopus, and California spiny lobsters. The ESA-listed Gulf grouper may occur in the Southern California Planning Area, using coastal habitats as juveniles before moving to slightly deeper rocky reefs, seamounts, and kelp beds as adults (NOAA 2016c). Several species of macroalgae are common in the Pacific Region. The best known of these species is the fast-growing giant kelp, which attaches to rocky substrates in less than 98 ft (30 m) of water. This species creates a unique 3-D structure and supports a rich community of marine life (Abbott and Hollenberg 1976; Druehl 1981; Graham et al. 2007). These subtidal kelp forests shrink and reappear each year (Edwards 2019; Krumhansl et al. 2016; Mumford Jr. 2007) and may have large-scale fluctuations resulting from influences such as the ENSO (Edwards and Estes 2006).

Submarine canyons, banks, and seamounts in the continental shelf of the Pacific Region are characterized by diverse R.4 **MARINE BENTHIC COMMUNITIES**. Cobb Seamount supports taxa that are common in coastal waters (Parker and Tunnicliffe 1994), including fleshy brown algae, coralline algae, sea urchins, and rock scallops. Scallops provide substrate for sea anemones, sponges, bryozoans (e.g., moss animals and sea mats), and tunicates (e.g., sea squirts) to live on. In deeper waters, echinoderms (such as crinoids, brittle stars, and predatory sea stars) are dominant. Along the large, rocky Heceta Bank, common species include basket and brittle stars, crinoids, sea cucumbers, sea urchins, several rockfish species, lingcod, flatfish, and shortspine thornyhead (Tissot et al. 2007). There are smaller rocky features off southern Oregon and northern California supporting a high diversity of species (Henkel et al. 2014). The complex bathymetry of the Southern California Bight has diverse habitats for various fishes and invertebrates. The Gorda and Juan de Fuca ridges host rich chemosynthetic communities (Van Dover 2014) (**Figure 2-10**). Several species of deepwater corals occur in the Pacific Region. For example, the Olympic Coast NMS, the Davidson Seamount, and parts of southern California contain a high abundance of gorgonian corals. Waters off southern California and the Olympic Peninsula host stony corals. Sea pens, soft corals, and lace corals thrive in a range of habitats (Kaplan et al. 2010).

Soft bottom habitats are common along the entire Pacific Coast. These mud and sand environments support benthic assemblages composed of clams, burrowing crustaceans, polychaetes, echinoderms, and mollusks, which can differ widely between different sediment types (Henkel et al. 2014). ESA-listed white abalone, a mollusk usually living in water 50 to 180 ft (15 to 55 m) deep, occurs in the Southern California Planning Area and may be found in soft substrates, feeding on kelp drifting from rocky

outcrops (NOAA 2016h). Crustaceans, such as Dungeness and red rock crabs, live on coarse sandy sediment along most of the Pacific Coast and support valuable R.10 **COMMERCIAL FISHERIES** (Iribarne et al. 1995; NMFS 2018b).

Over 90 species of bottom-dwelling groundfish—including rockfish, flatfish, and sharks—are managed along the U.S. West Coast and have R.6 **ESSENTIAL FISH HABITAT** in each of the Pacific planning areas (Pacific Fishery Management Council 2016b). Important benthic habitats occur in all Pacific planning areas and include canopy kelp, rocky reefs, and submerged aquatic vegetation (SAV) (e.g., seagrass beds), as well as a variety of submarine features, some of which have been designated HAPCs (Pacific Fishery Management Council 2016b).

Future Baseline Conditions (Figure 3-7). Seafloor resources, including R.4 **MARINE BENTHIC COMMUNITIES** and R.6 **FISH & ESSENTIAL FISH HABITAT**, may be affected by a variety of stressors such as climate change, fishing, marine mineral activities, and ongoing oil and gas activities. Although regulated activities are often required to avoid sensitive areas, bottom-contact activities are expected to continue and may impact marine benthic communities, especially in areas like NMSs. Increases in fishing activity and marine mineral dredging for beach renourishment may continue to disturb benthic habitat and affect both target species and bycatch. Expected decommissioning of oil and gas infrastructure and future offshore renewable energy development may likely have localized, short-duration impacts on the benthic ecosystem.

Warming ocean temperatures and ocean acidification may affect Pacific Region R.4 **MARINE BENTHIC COMMUNITIES**. Although climate change may affect kelp forest resilience and recovery (Edwards and Estes 2006), declining numbers of predators (e.g., crabs, large fish, sea stars) that control the population of kelp-leveling sea urchins may be one of the biggest threats to these diverse ecosystems (Rogers-Bennett and Catton 2019; Steneck et al. 2002). Like shell-building organisms, corals may have decreased size or slower growth due to ocean acidification. Changes in the climate may affect species such as crabs, because the timing of spring is closely correlated with crab larval settlement, subsequent adult abundance, and R.10 **COMMERCIAL FISHERIES** landings—though some crab species may experience declines while others increase (Shanks and Roegner 2007). Changes in regional water and air temperatures may affect rocky intertidal species (Helmuth et al. 2006) and be related to large disease events in sea stars (Miner et al. 2018) and other U.S. West Coast echinoderms.

Continued changes in environmental factors may lead to novel distributions and ranges of corals, R.6 **FISH**, and invertebrates. Current range shifts indicate a general movement of native species northward along the Pacific Coast. Projections for 2050 suggest, with low to moderate likelihood, that local extinctions of native species may occur more in the cold-water regions and less in southern California (Cheung et al. 2009). Potential consequences to the overall benthic community due to the arrival of new species are not fully understood.

2.7.4 Coastal Environment

Current Conditions (Figure 3-6). R.5 **COASTAL & ESTUARINE HABITATS** along the Pacific Region shoreline include island outcroppings, beaches, tidal flats, rocky shores, tidal rivers, wetlands, marshes,

estuaries, and SAV. These habitats support a wide variety of aquatic, estuarine, and marine communities, including habitat and nursery areas for juvenile R.6 **FISH**, shellfish, R.7 **BIRDS**, and other wildlife. Bays along the Pacific coastline also host a variety of macroalgae and invertebrate species, including several seagrasses, fiddler crabs, oysters, and mussels. The Pismo clam and Pacific razor clam, two species that burrow in sandy beaches, support R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in some areas (California Department of Parks and Recreation 2021; McLachlan et al. 1996). Sandy beaches also support additional burrowing invertebrates, including polychaete worms and sand crabs.

> Increased wave activity associated with the strong ENSO event in 2015–2016, along with long-term drought conditions and decreasing sediment flow in river discharges, has led to increased erosion of coastal environments from Washington through California in recent years (Barnard et al. 2017).

Pacific Region coastal estuaries and freshwater areas support R.6 **FISH**, particularly those that are anadromous. Adult Pacific salmon return to the same freshwater habitats and die after spawning; their carcasses supply the coastal ecosystem with a significant source of nutrients that sustain invertebrates, trout, otters, bears, eagles, and others (Pacific Fishery Management Council 2014). The coastal or connecting riverine waters of the Pacific Region contain various DPSs of protected steelhead trout and chum, coho, sockeye, and Chinook salmon; each of the Pacific planning areas contains critical habitat for one to five of these anadromous species (NOAA 2016f) (**Appendix D**). Coastal and freshwater R.6 **ESSENTIAL FISH HABITAT** for Chinook, coho, and Puget Sound pink salmon occurs in select freshwater spawning streams, estuaries, and coastal areas from the Washington/Oregon to Central California Planning Areas (Pacific Fishery Management Council 2014). Several stocks of Pacific salmon support an important R.10 **COMMERCIAL & RECREATIONAL FISHERY**.

The ESA-listed southern DPS of the North American green sturgeon uses marine waters in Alaska but spawns in freshwater streams off the U.S. West Coast. Because this anadromous fish spends time in both marine and fresh waters, designated critical habitat overlaps the Washington/Oregon, Northern California, and Central California Planning Areas out to 361 ft (110 m) deep and extends to connecting marshes, estuaries, streams, and heads of tide (**Appendix D**). The ESA-listed southern DPS of the anadromous Pacific eulachon has critical habitat in estuaries and freshwater streams that connect to the Washington/Oregon and Northern California Planning Areas. The ESA-listed tidewater goby is a small coastal and freshwater fish that has critical habitat in California.

Seals, sea lions, and sea otters are common semi-aquatic R.9 **MARINE MAMMALS** that depend on the coastal habitats to rest, breed, and nurse their young. Specifically, the Monterey Bay NMS serves as an important rookery for the northern elephant seal and haul-out area for a number of species, including the Pacific harbor seal, California sea lion, and Steller sea lion (Monterey Bay National Marine Sanctuary 2019).

The Pacific Flyway is an important migratory route for R.7 **BIRDS** and extends from the Alaskan and Canadian Arctic regions southward along the coasts of the U.S., Mexico, and South America to Patagonia. Some species of migrating birds follow the coastline from Alaska to winter in the Pacific

Region, while others continue to migrate down the coast and winter south of the U.S. Key resting and foraging areas along the flyway in the Pacific Region include San Francisco, Monterey, and San Diego Bays. Nearshore species generally occupy relatively shallow waters and take advantage of tides to feed on exposed invertebrates. Common nearshore birds include scoters, loons, grebes, gulls, and terns. Nearshore species occur in highest numbers during the winter months; relatively few remain during the summer. There are four ESA-listed coastal bird species in the Pacific Region: western snowy plover, California Ridgway's rail, light-footed Ridgway's rail, and California least tern. Degradation and disturbance to key resting and foraging areas may decrease available stops along the flyway.

Future Baseline Conditions (Figure 3-7). Ongoing stressors—such as climate change, vessel traffic, coastal development, eutrophication, pollution, existing river dams, and dredging—are expected to continue in the coming years and could strain coastal areas. Sea level rise and a potential increase in storms may inundate and damage **R.5 COASTAL & ESTUARINE HABITATS** (Cai et al. 2014). In some coastal areas such as the San Francisco Bay, erosion is likely to continue due to reduced sediment supply from upstream damming (Barnard et al. 2012). Further erosion may degrade coastal ecosystems and affect resident and migrating **R.7 BIRDS**, as well as **R.9 MARINE MAMMALS** that utilize these areas to rest and birth or nurse their young. Sea otters are particularly vulnerable to marine pollution, especially oil, because their fur must remain clean to keep its insulating properties (Jessup et al. 2004). Sea otters may also ingest harmful or toxic contaminants while grooming their fur.

Warming ocean temperatures and ocean acidification may create inhospitable areas in Pacific estuaries and have consequences for regional **R.6 FISH** and **R.10 COMMERCIAL & RECREATIONAL FISHERIES** (Keppel et al. 2016; Miller et al. 2016). For example, the valuable oyster fishery in the Washington/Oregon Planning Area faces continued threats from eutrophication, river discharge, and coastal ocean acidification from carbon dioxide-enriched upwelling (Eastern Oyster Biological Review Team 2007; Ekstrom et al. 2015). Overall, Pacific coastal habitats are expected to continue to support fisheries at current levels (NMFS 2021b). However, additional stress from warming ocean temperatures and ocean acidification may further impact some species that are currently overfished or threatened with habitat destruction. Expected increases in tourism may also lead to more plastic pollution, coastal development, and recreational fishing pressure.

2.7.5 Human Environment

Current Conditions (Figure 3-6). Communities in the Pacific Region are diverse. Generally, California is more populated and industrialized than Washington and Oregon, but there are urban and rural pockets along the entire coast. In 2018, the ocean economy employed 784,531 people (3.4% of total regional employment), bringing in $70.4 billion dollars (1.8% of total GDP in the region) (NOAA and Office for Coastal Management 2022). **R.15 RECREATION & TOURISM** is the most important sector for the Pacific Region's ocean economy. This region is also critical for the Nation's marine transportation capabilities, as some of the Nation's largest deepwater ports are in the Pacific Region (NOAA and Office for Coastal Management 2019b). The marine transportation sector was also the fastest growing in 2018, adding about 14,000 jobs and experiencing the highest gains in GDP (NOAA and Office for Coastal Management 2021).

The Pacific Region accounts for approximately 10% of the total U.S. R.10 **COMMERCIAL FISHERIES** harvest (landings) (NMFS 2021b). Washington State generated the greatest revenues ($249 million), followed by California ($183 million), and Oregon ($172 million) (NMFS 2021b). Based on landings revenue, some of the Pacific Coast's most valuable commercial species include crab (e.g., Dungeness crab), shellfish (e.g., oysters), shrimp, whiting (hake), salmon, and squid. When imports are excluded, Washington produced the greatest number of jobs in the commercial fisheries sector among the states in the Pacific. California produced the highest income ($6.1 billion) generated by the seafood industry in the Nation, with Washington recording the fifth highest ($2.2 billion) (NMFS 2021b). In 2018, revenue from recreational fishing across the Pacific Region totaled about $5.4 billion. California generated the region's greatest number of jobs (21,145) and income ($961 million) from the R.10 **RECREATIONAL FISHERIES** sector, followed by Washington in both jobs (5,450) and income ($268 million). Popular sport fishing species in the region include rockfishes, Pacific barracuda, and surfperches.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES** along the Pacific Coast and offshore are heavily influenced by several different geologic and environmental processes (e.g., chemical and physical weathering) that have affected site formation and site preservation on the Pacific OCS. Despite the dynamic environment, many thousands of archaeological sites and historic properties have been identified along the coasts and offshore waters of Washington, Oregon, and California. These sites include pre-contact period sites dating from 14,000 years before present and historic period sites dating from the 18th century (Braje et al. 2019; ICF International et al. 2013).

R.12 **LAND USE** on the Pacific Coast includes a mix of public, private, and Tribal lands. Dominant uses of the coastal areas of the Pacific Region include commercial and recreational fishing, shipping, and military use, with other activities occurring closer to shore and near ports (D'lorio et al. 2015). Land use within each ecoregion varies based on how developed the area is and the needs of the population and businesses. Onshore areas adjacent to the Washington/Oregon Ecoregion are largely undeveloped or rural as major population centers are inland (USDA 2017). The Federal Government manages approximately one-third of Washington lands and half of Oregon lands. Key industries have shaped coastal land use issues in Washington and Oregon, particularly shipping, aquaculture, seafood processing, timber, and R.15 **RECREATION & TOURISM** (Artifacts Consulting Inc. 2011; Bates et al. 2018; Hoelting and Burkardt 2017). Shoreline development in southern Washington (south of Olympic Coast National Park) is primarily driven by construction for vacation and retirement homes (Bates et al. 2018). The California Current Ecoregion is a mix of urban and rural areas. Northern and central California are primarily rural and forested, except for the urban San Francisco Bay area, while southern California has large urban centers in Los Angeles, Orange, and San Diego Counties (U.S. Census Bureau 2010; USFS 2016). The Federal Government manages roughly 46% of California lands (Vincent et al. 2017). Agriculture is an economically important land use; California ranked number one in the Nation for crop cash receipts in 2017, with the top commodities being dairy, grapes, and almonds (California Department of Food and Agriculture 2018).

Natural resource-based industries (i.e., timber and forest products, fishing, seafood processing, ship building, aquaculture, tourism) play an important role in the area's R.13 **CULTURE** (Bates et al. 2018; Hoelting and Burkardt 2017). The rugged coastal landscapes and abundant natural resources of the

highest productivity occurring along the coasts and gradually declining with distance from shore (Karnauskas et al. 2013). Beyond the shelf edge, nutrient availability is much lower and, consequently, phytoplankton productivity is low. Intrusions of the Loop Current bring low nutrient waters into the GOM, and fronts created by interactions between associated warm and cold-core Loop Current eddies can be important spawning and feeding sites for pelagic species (Zimmerman and Biggs 1999) as they concentrate plankton in otherwise food-poor areas. The Loop Current and its eddies are critical means of larval transport and major drivers of zooplankton abundance and distribution (Biggs and Ressler 2001; Lindo-Atichati et al. 2012; Muller-Karger et al. 2015).

R.3 **PELAGIC COMMUNITIES** include larvae from a wide variety of R.6 **FISH** species, which provide important food resources for larger animals (Biggs and Ressler 2001; Cardona et al. 2016; MacDonald et al. 2015). Hypoxia in shallower waters may also decrease zooplankton concentrations (Kimmel et al. 2010). The composition of pelagic fish varies from the inner shelf (e.g., seatrout and cobia), to middle shelf (e.g., snappers and jacks), and to deep waters (e.g., tunas and mesopelagic fish like lanternfish and bristlemouths) (Biggs and Ressler 2001; Ditty et al. 1988; Muhling et al. 2012). Gulf menhaden inhabit GOM shelf waters to 328-ft (100-m) depth and support one of the largest R.10 **COMMERCIAL FISHERIES** in the U.S. Pelagic species—such as the blue marlin, tuna, and sharks—are often among the top predators. These open-ocean animals can travel long distances and occupy a wide geographic area; many pelagic fishes have R.6 **ESSENTIAL FISH HABITAT** in the GOM and are present seasonally or year-round (**Appendix E**). Many fish, including some highly migratory species such as Atlantic bluefin tuna, spawn in the GOM in late spring and early summer. The Flower Garden Banks NMS in the northern GOM is an important nursery habitat for the ESA-listed giant manta ray (Miller and Klimovich 2017; Stewart et al. 2018). The ESA-listed oceanic whitetip and scalloped hammerhead sharks are both found in GOM offshore waters.

Brown algae *Sargassum* is an important feature of GOM pelagic waters; it can cover widespread areas and form floating mats large enough to be detectable by satellite (Hardy et al. 2018; Hu et al. 2016). *Sargassum* mats also provide food and protection from predation for a wide spectrum of fauna, including larval and juvenile R.6 **FISH** and R.8 **SEA TURTLES** (Casazza and Ross 2008; Dooley 1972). Because of the abundance of small fishes that typically assemble under *Sargassum* mats, larger predatory fish, R.7 **BIRDS**, and R.9 **MARINE MAMMALS** routinely forage in the vicinity of *Sargassum* mats (Casazza and Ross 2008; Moser and Lee 2012).

Common pelagic R.7 **BIRDS** include shearwaters, storm-petrels, boobies, northern gannets, jaegers, phalaropes, petrels, gulls, and terns (Duncan and Havard 1980). Several of these species rely on the *Sargassum* mats to feed and rest (Moser and Lee 2012). Recent studies indicate that the black-capped petrel, under consideration for listing under the ESA, can be found in the northern GOM (Jodice et al. 2021). Species abundance varies by season and in relation to medium-scale features (e.g., the Mississippi River freshwater plume and oceanic eddies) (Ribic et al. 1997).

Five species of ESA-listed R.8 **SEA TURTLES** occur in the GOM planning areas: loggerhead, green, hawksbill, Kemp's ridley, and leatherback (NOAA 2015d). All these species rely on coastal and pelagic waters for foraging needs (Bjorndal 1997; Collard 1990; Davis and Fargion 1996; Fritts et al. 1983a; Fritts

et al. 1983b; Godley et al. 2008; NMFS and FWS 2015). Loggerhead turtles range from tropical to temperate regions around the world, but the GOM is a particularly important area for this species. Floating *Sargassum* patches in the Western and Central GOM Planning Areas are federally designated under the ESA as critical habitat for loggerhead turtles (**Appendix D**). The area from Mississippi Canyon to DeSoto Canyon is an important habitat for leatherback turtles, especially near the shelf edge (Davis et al. 2000). NMFS has proposed to designate marine critical habitat in nearshore waters (from the mean high-water line to 20-m depth) off the coasts of Florida and Texas. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM (88 FR 46572).

The following threatened or endangered species have critical habitat designated within BOEM planning areas in the GOM Region (detail and map in ***Appendix D****):*

Elkhorn and **staghorn corals**: Eastern GOM

Gulf sturgeon: Eastern GOM

Smalltooth sawfish: Eastern GOM, Straits of Florida

Loggerhead turtle: Western, Central, and Eastern GOM

Twenty-one species of R.9 **MARINE MAMMALS** regularly occur in the GOM pelagic environment: a unique evolutionary lineage of baleen whale (Rice's whale, also known as the Gulf of Mexico whale, which was previously considered to be the GOM subpopulation of Bryde's whale) and 20 species of toothed whales and dolphins. Both the Rice's and sperm whale are ESA-listed and have presumed year-round resident populations in the GOM (NMFS 2020a; Van Parijs 2015). The best abundance estimate available for northern GOM Rice's whales is 33 individuals (Hayes et al. 2018); therefore, any mortality events could affect the population's survival. Sperm whale occur throughout the GOM and can dive to depths exceeding 10,000 ft (3,048 m) to feed. The best abundance estimate available for sperm whales in the GOM is 763 individuals; they exhibit a geographic social structure, where females and juveniles of both sexes occur in mixed groups (Hayes et al. 2018; NMFS 2020a).

Sighting records and acoustic detections of Rice's whales in the northern GOM occur almost exclusively in the northeastern Gulf in the DeSoto Canyon area (Hayes et al. 2018). However, recent limited evidence shows that the Rice's whale may be present in the area between the 100-m and 400-m isobaths across the northern GOM (Soldevilla et al. 2022). In 2023, NMFS issued a proposed critical habitat designation for Rice's whale (88 FR 47453); the proposed designation includes waters from the 100-m isobath to the 400-m isobath in the GOM. BOEM expects that NMFS may issue the final critical habitat designation early in the 2024–2029 Program and that the critical habitat designation for Rice's whale will be considered as appropriate in the analyses and preparation leading to individual lease sale decisions under the 2024–2029 Program. As appropriate at the lease sale stage, USDOI may offer additional mitigations or exclude acreage from the sale area to protect listed species and their habitat, including but not limited to the Rice's whale.

In 2022, BOEM and BSEE reinitiated consultation for GOM OCS oil and gas activities addressed in the 2020 biological opinion (as amended) issued by NMFS, in light of new oil spill risk analyses and to incorporate certain conditions of approval previously discussed with NMFS. The Bureaus also indicated

coastal communities, particularly R.14 **VULNERABLE COASTAL COMMUNITIES**, in the GOM. In addition, offshore hypoxia has persisted for years (with variations in intensity and size) and is expected to remain for decades to come, with varying effects on the coastal ecosystem. Any stressors that lead to the degradation or loss of key habitat areas for estuarine R.6 **FISH**, shellfish, and R.7 **BIRDS** would likely put additional stress on these species.

Past, current, and future oil and gas activities in the GOM will likely continue to put pressure on R.5 **COASTAL & ESTUARINE HABITATS** and their associated fauna and flora. Persistent long-term effects of the *Deepwater Horizon* oil spill (such as shoreline vegetation loss), may continue in coastal and estuarine wetlands (Turner et al. 2016). Health issues (such as being particularly susceptible to contaminant exposure following *Deepwater Horizon*) were observed in some populations of bottlenose dolphins in heavily oiled coastal areas (Venn-Watson et al. 2015). These studies suggest that some populations may be more susceptible to impacts from additional oil and gas activities.

Populations of coastal R.7 **BIRDS** may continue to be stressed by exposure to routine and accidental discharges and increasing vessel traffic. Similarly, stressors such as water pollution and habitat disturbance, vessel traffic, coastal lighting, and fishing entanglements may continue to impact R.8 **SEA TURTLES** and R.9 **MARINE MAMMALS**.

2.8.5 Human Environment

Current Conditions (Figure 3-10). Communities in the GOM Region depend on the ocean economy for employment and income. In 2019, over 616,000 people were employed in coastal industries (2.8% of total employment in the region), bringing in $115 billion dollars in GDP (4.3% of total GDP in the region). GOM's ocean economy is heavily influenced by the R.15 **RECREATION & TOURISM** industry, which provides for over half of the jobs in this sector, and offshore oil and gas activities, which generate 70% of GDP (NOAA and Office for Coastal Management 2021; 2022). The GOM contributes the highest percentage of GDP in the entire U.S. ocean economy, with Texas contributing a majority of that percentage due to the offshore oil and gas industry (NOAA and Office for Coastal Management 2019b). GDP in the GOM ocean economy increased by 41% from 2009–2019, driven by changes in resource pricing (NOAA and Office for Coastal Management 2021). The oil and gas industry sector as a whole has been operating for decades and plays a central role in the employment base for the Western and Central GOM Planning Areas (Louisiana State University 2017). In contrast, the Eastern GOM Planning Area has few active leases off Florida's Gulf Coast.

The GOM is home to some of the world's most productive R.10 **COMMERCIAL & RECREATIONAL FISHERIES**. The region accounts for approximately 20% of the total domestic commercial and recreational harvest (landings) each year, sustaining the livelihoods of thousands of fishermen and their families, and providing a way of life for coastal communities. Shrimp, menhaden, oysters, and blue crab are some of the Gulf's most important commercial species. The revenue derived from commercial harvest in the GOM accounts for a quarter of the total commercial fishery revenue in the U.S. and is worth approximately $890 million annually (NMFS 2021b). Based on landings revenue, shrimp is the largest fishery in the region, followed by the menhaden and oyster fisheries (NMFS 2021b). Florida generates 126,826 jobs (71,419 on the Gulf Coast and 55,407 on the Atlantic Coast) from recreational

fishing, the largest in the Nation. Recreational fishermen in Florida took the most trips (85 million) in the region and in the Nation (NMFS 2021b). Popular GOM sport fishing species include tarpon, red drum, grouper, tuna, mahi-mahi, marlin, and sharks. Gulf Coast estuaries and coastal marshes provide nursery habitat for these commercially valuable marine species.

The GOM coastal zone provides significant ecological and economic value to the region and holds important R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**. Shipwrecks are scattered throughout the GOM at all water depths. During oil and gas exploration, many shipwrecks have been discovered and listed to the National Register. BOEM's marine archaeologists created virtual 3D models using video footage of a small selection of some of the shipwrecks identified through oil and gas surveys. BOEM posted these sites on the Virtual Archaeology Museum web page at www.boem.gov/environment/virtual-archaeology-museum. The GOM coastline contains archaeological, cultural, and historic sites, many of which are listed on the National Register.

R.12 **LAND USE** in coastal areas of the GOM is a mix of urban, industrial, and rural activities, including manufacturing, shipping, agriculture, and recreation. The Gulf Coast, particularly in the Western and Central GOM Planning Areas, is known for an established offshore oil and gas industry with a network of related onshore support industries. Onshore areas in the Western and Central GOM Planning Areas host an expansive network of oil and gas infrastructure industry, which includes an array of services such as construction facilities, service bases, product transportation, and processing facilities (Dismukes 2010; 2011; The Louis Berger Group Inc. 2004). Other important Gulf Coast industries include commercial shipping, fisheries, tourism, and hospitality (i.e., hotels and restaurants). More than half of the 20 largest U.S. ports are along the Gulf Coast, mostly along the Western and Central GOM Planning Areas (Industrial Economics Inc. 2014).

The GOM Coast has numerous state parks, beaches, and important environmental features that support multiple uses, including R.10 **COMMERCIAL & RECREATIONAL FISHERIES** and R.15 **RECREATION & TOURISM**. Notable features include Padre Island National Seashore, Atchafalaya Basin, Mississippi River Delta, Gulf Islands National Seashore, Mobile Bay, Key Biscayne, and Everglades National Park (BOEM 2016d). Parts of the GOM's sandy seafloor support marine mineral dredging on the OCS to address erosion along beaches and to strengthen the resilience of coastal communities and infrastructure. Since 1995, over 50 million and 2.8 million cubic yards of sand have been leased in the Central and Eastern GOM Planning Areas, respectively (BOEM 2018d).

The R.13 **CULTURE** of the GOM Region varies greatly, from Houston, TX (the fourth most populous city in the U.S.), to smaller metropolitan areas (e.g., Corpus Christi, Galveston, New Orleans, Mobile, Tampa), and to Louisiana's largely undeveloped bayous, inhabited by Tribal and Cajun communities. Culture is also strongly tied to R.10 **COMMERCIAL & RECREATIONAL FISHERIES**, the oil and gas industry, R.15 **RECREATION & TOURISM** (fueled by beaches, especially on the Alabama and Florida Coasts, and vibrant tourist destinations, such as Key West and New Orleans), and the socioeconomic impacts of these industries. GOM's population comprises diverse sociocultural backgrounds. Fishing and shrimping are part of the traditional livelihood for many coastal communities (Austin et al. 2014) and serve as a source of income and subsistence (Regis and Walton 2022). Harvest, sharing, and use of wild resources,

including coastal fishing and shrimping activities, are an important part of many rural residents' and communities' cultural connection to the region (Regis and Walton 2022). Some counties and parishes, particularly Harris County, TX, and Lafourche Parish, LA, are more closely connected to the offshore oil and gas industry than others (BOEM 2017c).

The GOM Region is still recovering from the adverse effects of recent hurricanes and the *Deepwater Horizon* oil spill. Coastal land loss continues to have a long-term impact on Louisiana R.14 **VULNERABLE COASTAL COMMUNITIES** (**Figure 2-13**). These events have had disproportionate effects on minority and low-income populations, especially in coastal areas and zones in Louisiana outside levee protection (Hemmerling and Colten 2004; Peterson 2012), and these groups are more vulnerable to any new hazards or natural disasters (Goldstein et al. 2011).

Residents of coastal areas bordering the Western and Central GOM Planning Areas have an average poverty rate of 17.2% (U.S. Census Bureau 2019a; 2019k; 2019p; 2019u; 2019y), exceeding the national average of 11.8% (U.S. Census Bureau 2019z). Some counties in the Western GOM Planning Area (e.g., Kleberg, Willacy, and Cameron counties in Texas) have average rates at or above 25% (U.S. Census Bureau 2019a). On average, minority populations in coastal counties and parishes adjacent to the Western and Central GOM Planning Areas make up 61.8% of the population (U.S. Census Bureau 2019a; 2019b; 2019k; 2019p; 2019u; 2019y), with the highest percentage (91.5%) in Willacy County, TX (U.S. Census Bureau 2019a). Over 60% of the coastal counties and parishes adjacent to the Western and Central GOM Planning Areas have minority populations above the national average of 39.9% (U.S. Census Bureau 2019a; 2019b; 2019k; 2019p; 2019u; 2019y; 2019z).

Vulnerable coastal communities in the Western and Central GOM Planning Areas face historic, ongoing, and potential future burdens resulting from land use and industrial development patterns, land loss and sea level rise, and changes in storm frequency and intensity. In some areas in the region, residents of low-income and racial and ethnic minority communities have been disproportionately impacted by pollution related to industrial activity. In Louisiana, for example, Terrell and St. Julien (2023) documented that communities of color were exposed to 7- to 21-fold higher emissions of criteria air pollutants from oil and gas processing and petrochemical manufacturing facilities than predominantly white communities. Though the impacts were documented in industrialized census tracts statewide, the heaviest concentration of oil and gas processing and petrochemical facilities are within the Industrial Corridor of the lower Mississippi River, between Baton Rouge and New Orleans—an area commonly referred to as "Cancer Alley" (Terrell and St. Julien 2023).

Disparities in health outcomes for low-income and minority communities near oil and gas processing and petrochemical facilities have been described in several areas of the GOM Region, including communities in Louisiana and Texas (Fleischman and Franklin 2017; Johnston and Cushing 2020; Terrell and St. Julien 2023). In addition to emissions-related pollution, minority and low-income communities are often in closest proximity to industrial facilities, and they may bear a disproportionate burden of impacts from industrial accidents and chemical releases linked to extreme weather events, with documented instances of health impacts following accidental and natural disaster-related pollutant releases (Johnston and Cushing 2020). Minority and low-income communities in the GOM Region that

2.9 ATLANTIC REGION

Figures 3-14 and 3-15 show the Atlantic Region's current conditions and future baseline conditions.

The Atlantic Region includes 28,673 mi (46,145 km) of shoreline from Maine to the Florida Straits (NOAA 2016e). This region comprises two BOEM ecoregions spanning four planning areas—the Northeast U.S. Continental Shelf (NECS) Ecoregion and Southeast U.S. Continental Shelf (SECS) Ecoregion (**Figure 2-4**). The NECS Ecoregion includes all of the North Atlantic Planning Area and the northern portion of the Mid-Atlantic Planning Area to Cape Hatteras, NC. The SECS Ecoregion stretches from North Carolina to Florida, and includes the Straits of Florida Planning Area, South Atlantic Planning Area, and the southern portion of the Mid-Atlantic Planning Area. Currently, there are no active oil and gas leases in the Atlantic Region.

2.9.1 Physical Environment

Two primary current systems in the Atlantic Region essentially divide the NECS and SECS Ecoregions: the Labrador Current flows southward from the Arctic, and the Gulf Stream flows northward from the GOM (**Figure 2-14**). The Hatteras middle slope lies at the junction of the two ecoregions and is one of the steepest slope environments along the U.S. East Coast. The physical geography of this region leads to complex interactions of these two major currents and influences the position of ocean fronts, stratification of the water column, and upwelling events (Andres 2021; Churchill and Berger 1998), which help drive patterns of productivity and faunal diversity. The Gulf Stream turns east near Cape Hatteras, where eddies may break off and continue northward; these eddies typically have a cold core of slope water surrounded by a warm ring of Gulf Stream water.

The Atlantic Region geological and seafloor environment is diverse and characterized by a patchy distribution of sandy sediments and hard bottom features. Both shallow, warm-water and deep, cold-water coral reefs are found in the region. The NECS has a large number of submarine canyons, including 13 major canyons such as the Baltimore, Washington, and Norfolk Canyons in the Mid-Atlantic Bight (CSA Ocean Sciences Inc et al. 2019; Ross and Brooke 2012). The Atlantic canyons are analyzed as potential exclusions in **Section 4.5**.

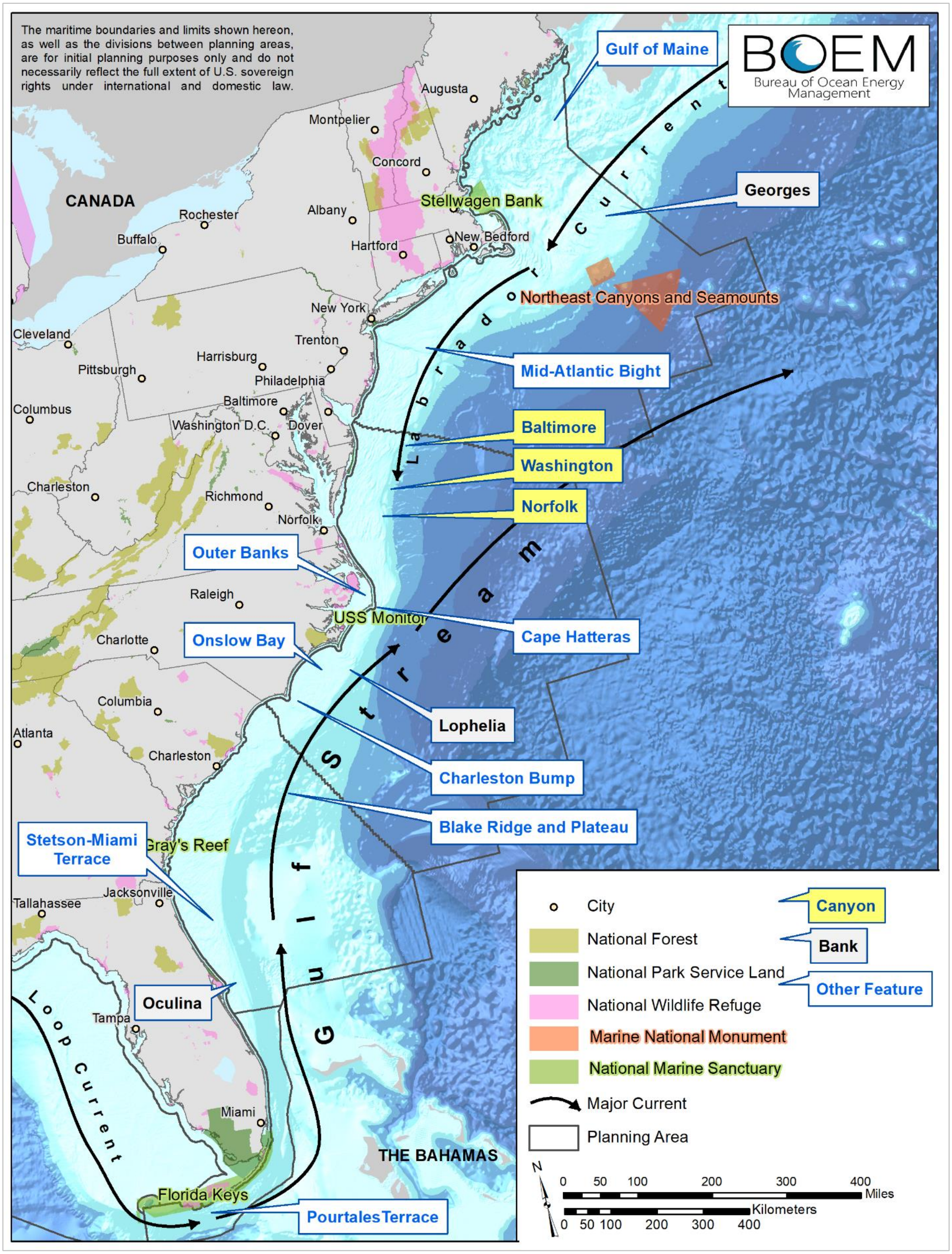


Figure 2-14. Atlantic Region physical, political, and land management features

Current Conditions (Figure 3-14). R.1 **AIR QUALITY** along the majority of the Atlantic Coast is in attainment with the NAAQS. However, O_3 nonattainment areas cover much of the Washington, DC; Baltimore, MD; Harrisburg and Philadelphia, PA; Wilmington, DE; and New York, NY, metropolitan areas, along with two SO_2 nonattainment area covering part of suburban Baltimore, MD, and southern New Hampshire. New York County, NY, also known as Manhattan, is classified as nonattainment for PM_{10}; Eastern Pennsylvania has two $PM_{2.5}$ nonattainment areas (USEPA 2018c) (**Figure 2-6**).

The overall R.2 **WATER QUALITY** condition of the Atlantic Region is rated as fair (USEPA 2012). Water quality in coastal waters of the Atlantic Region is impacted primarily by terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Activities that impact water quality include urbanization; forestry practices; municipal waste discharges; agriculture; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military and NASA operations; renewable energy development; natural events; and climate change. Plumes from the Chesapeake and Delaware Bays, two prominent estuaries along the NECS Ecoregion, influence coastal water quality by increasing turbidity and adding nutrients. These extensive watersheds funnel nutrients, sediment, and organic material into secluded, poorly circulated estuaries that are more susceptible to eutrophication; this pattern closely correlates with population density (USEPA 2012).

Future Baseline Conditions (Figure 3-15). R.1 **AIR QUALITY** in areas near the Atlantic OCS is expected to improve as the existing nonattainment areas come into compliance with the CAA during the coming decades. Emissions sources (such as seaports, airports, vehicles, power plants, and industrial emissions) likely would continue to cause onshore NAAQS exceedances in the near term.

Stressors likely will continue to influence R.2 **WATER QUALITY**. Terrestrial point and non-point source discharges, as well as atmospheric deposition, are expected to continue at present or greater levels and may continue to impact water quality. An increase in activities (e.g., harbor, port, and terminal operations), urbanization, and climate change is also expected, which may contribute to declining water quality in the future.

2.9.2 Pelagic Environment

Current Conditions (Figure 3-14). The R.3 **PELAGIC COMMUNITIES** in the Atlantic Region vary significantly among different water masses and are impacted by seasons, weather, and shelf circulation processes (Lohrenz et al. 2003). Primary productivity is higher in waters of the Labrador Current than in the Gulf Stream (**Figure 2-14**) and is generally highest when waters become re-stratified in spring and summer (Marra and Ducklow 1995). Nutrient-rich, off-shelf water upwells in the core of eddies that form near the deflection of the Gulf Stream; these eddies are important drivers of primary productivity, which in turn leads to high concentrations of zooplankton (Govoni et al. 2010). South of Cape Hatteras, a semi-permanent eddy called the Charleston Gyre supports high chlorophyll concentrations and zooplankton densities (Govoni et al. 2010). This feature serves as important habitat for larval R.6 **FISH** and the black-capped petrel (White 2020b), which has been proposed for listing under the ESA.

Pelagic communities include larvae of R.6 **FISH** and invertebrates (including important R.10 **COMMERCIAL & RECREATIONAL FISHERIES** species), as well as food sources for other pelagic animals, including R.9 **MARINE MAMMALS** (Kenney et al. 1997). In the NECS, copepods and krill support the feeding and migration pathways of large baleen whales (Gavrilchuk et al. 2014), particularly the North Atlantic right whale. Forage fish, such as Atlantic herring and Atlantic mackerel, form large schools in the pelagic zone, concentrating in areas with high zooplankton density (Bachiller et al. 2016). Common pelagic invertebrates include cephalopods, such as longfin, arrow, and shortfin squid (Herke and Foltz 2002), which provide food for toothed whales (Kenney et al. 1997).

In the pelagic zone, highly migratory managed R.6 **FISH** species include tuna, sharks, and billfish, many of which travel long distances across domestic and international boundaries. Most of these species, like the Atlantic bluefin tuna, blue shark, and white marlin, have R.6 **ESSENTIAL FISH HABITAT** in all four Atlantic planning areas (NMFS 2017) (**Appendix E**). In the Atlantic Region, nine highly migratory species are already overfished, and overfishing is occurring on six of those species (NMFS 2019). Additionally, ESA-listed oceanic whitetip shark and the Central and Southwest DPSs of scalloped hammerhead shark occur in all Atlantic planning areas (NOAA 2015c). The ESA-threatened giant manta ray occurs in tropical to temperate waters; though it is not commonly encountered, it is susceptible to targeted and bycatch fishery harvest (Miller and Klimovich 2017). The Atlantic canyons are areas of importance to highly migratory and deepwater fishes and are sites of intense R.10 **COMMERCIAL & RECREATIONAL FISHERIES** (e.g., tilefish, lobsters, red crab, tunas, swordfish) (BOEM 2016d).

Communities of Atlantic marine R.7 **BIRDS** feed along the shelf break near Gulf Stream eddies and shallow banks in areas where prey are concentrated (Lee 2015; Nisbet et al. 2013; Palka et al. 2017). Notable offshore areas with persistent concentrations of seabirds include the Bay of Fundy (where phalaropes feed upon copepods and krill), Georges Bank (where tidal fronts concentrate R.6 **FISH** and zooplankton prey, attracting shearwaters and storm-petrels in summer and Atlantic puffins in winter), and Nantucket Shoals (where hundreds of thousands of sea ducks and loons feed in winter and spring on clams, crustaceans, and fish) (Nisbet et al. 2013; Veit et al. 2016; White and Veit 2020). The black-capped petrel forages in hot spots seaward of Cape Hatteras, NC; near the Atlantic shelf break and submarine canyons system; and in Gulf Stream waters in the South Atlantic Bight (Halpin et al. 2018; Jodice et al. 2015; Winship et al. 2018).

The Loop Current and Gulf Stream are estimated to transport over one million tons of *Sargassum* seaweed from the GOM into the Atlantic Ocean during fall and winter (Gower and King 2011). The distribution and quantity of *Sargassum* along the Atlantic Coast varies (Casazza and Ross 2008), extending as far north as the Mid-Atlantic Planning Area (Dooley 1972). This floating seaweed is important because it provides a place to rest and forage for juvenile R.8 **SEA TURTLES**. As a result, *Sargassum* is a pelagic HAPC and is designated as critical habitat for hatchling loggerhead turtles in the Mid-Atlantic and South Atlantic Planning Areas.

The following threatened or endangered species have critical habitat designated within BOEM planning areas in the Atlantic Region (detail and map in ***Appendix D****):*

North Atlantic right whale: North Atlantic, Mid-Atlantic, South Atlantic

Loggerhead turtle: North Atlantic, Mid-Atlantic, South Atlantic, Straits of Florida

Elkhorn and staghorn corals: Straits of Florida

Five ESA-listed R.8 **SEA TURTLES** occur in the Atlantic Region. Loggerhead turtles are the most abundant sea turtle in U.S. waters. The Northwest Atlantic DPS of loggerhead occurs along the U.S. Southeast Coast (NOAA 2017d). Critical habitat for loggerhead turtles has been designated for varying life stages on nesting beaches, in nearshore waters, and offshore from North Carolina to Florida (NOAA 2017d). Leatherback turtles occur in the open ocean from Maine to Florida, diving to depths of 4,000 ft (1,220 m) in search of gelatinous prey (NOAA 2016d). The North Atlantic DPS of green turtles and Kemp's ridley turtles inhabit waters along the Atlantic Coast, with the latter ranging farther north during warmer months and moving south during winter and early spring (NOAA 2017c; 2018). NMFS has proposed to designate marine critical habitat in nearshore waters (from the mean high-water line to 20-m depth) off the coasts of Florida and North Carolina. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM and Atlantic Ocean (88 FR 46572). Hawksbill turtles spend time in both pelagic and coastal areas; this species is primarily tropical and subtropical and is found regularly offshore Florida (NMFS 2020b). In the pelagic environment, sea turtle populations are at risk for entanglement and interaction with marine debris, fisheries bycatch, and ship traffic. From 2012–2016, 841 sea turtles were killed as bycatch in the Atlantic sink gillnet fishery alone (Benaka et al. 2019).

Five ESA-listed R.8 **SEA TURTLES** occur in the Atlantic, with most concentrated in the South Atlantic and ranging farther north during warmer months. Females nest on sandy beaches in the southeast U.S., especially in Florida. Because they are slow growing, sea turtle populations are vulnerable to disruptions and require time to recover.

Thirty-nine species of R.9 **MARINE MAMMALS** occur in the western North Atlantic: 7 species of baleen whales, 27 species of toothed whales and dolphins, and 4 species of seals. Five ESA-listed species include the North Atlantic right, blue, fin, sei, and sperm whales. Baleen whale species occur in highest abundance in the NECS (especially the Gulf of Maine) following the seasonal zooplankton blooms, and many individuals subsequently migrate to southern waters in winter to breed (Roberts et al. 2016). Small dolphin species more frequently inhabit nearshore waters, especially near Cape Hatteras, where the major currents mix (Roberts et al. 2016). Deep-diving species, like beaked and sperm whales, tend to prefer deeper waters off the shelf break, particularly in the waters overlying and surrounding the Atlantic canyons, where they feed on aggregations of pelagic R.6 **FISH** and squid (Moors-Murphy 2014; Roberts et al. 2016; Stanistreet et al. 2017). Canyon areas in the North Atlantic and Mid-Atlantic Planning Areas (**Figure 2-14**) are an important high-use area for cetaceans, some of which spend the majority of the year in this area (Stanistreet et al. 2017).

The North Atlantic right whale is a species of very high concern. Its small population—currently estimated at around 400 individuals—has recently shown trends of sharp decline (Kraus et al. 2016; Pace III et al. 2017). Mortality is primarily caused by entanglements and vessel strikes (Rolland et al. 2016; Sharp et al. 2019). Around 80% of the population of North Atlantic right whales has been entangled in fishing gear at least once (Knowlton et al. 2012).

At present, the North Atlantic right whale is the only ESA-listed cetacean with critical habitat in the North Atlantic. There are two critical habitat areas for North Atlantic right whales: feeding grounds in the Gulf of Maine and a calving habitat about 62.1 mi (100 km) wide off the coast of northern Florida, Georgia, and South Carolina (White and Veit 2020). A recent study tracked the location of North Atlantic right whales over a 10-year period and found that their distribution is broader than previously thought; North Atlantic right whales were present along the entire eastern seaboard for most of the year (Davis et al. 2017). After 2010, the North Atlantic right whale general distribution showed a more southerly trend (Davis et al. 2017), though recent data shows that other North Atlantic right whales are moving farther north (Meyer-Gutbrod et al. 2018), likely in response to rapid warming and changing food webs in the Gulf of Maine. The North Atlantic right whale's migration route directly overlaps some of the busiest shipping lanes in the entire OCS, putting the population at risk of interactions with ships. Thirty-four individuals have died since 2017, and an additional 16 free-swimming whales have been documented with serious injuries (Meyer-Gutbrod et al. 2018; NOAA 2021b). In 2017, elevated numbers of dead or seriously injured North Atlantic right whales led to the declaration of a UME (NOAA 2020a). The leading cause of death for this UME is attributed to "human interaction," specifically from entanglements or vessel strikes.

In 2021, an UME was also declared for Florida's Atlantic Coast manatee population due to significant die-offs, despite years of population growth (Florida Fish and Wildlife Conservation Commission 2022). Researchers attribute the UME to starvation due to the lack or seagrasses in the Indian River Lagoon, where poor water quality has led to HABs and widespread seagrass loss in recent years.

Two species of seal are commonly found in the Atlantic Region; the harbor seal has the greatest range (from Maine to the Carolinas), while the gray seal is found north of New York. Three other species—harp, hooded, and ringed seals—are infrequent visitors to the region. Harp, hooded, and ringed seals usually associate with pack ice but may occur in pelagic waters in the northern parts of the NECS (Kovacs 2015a; 2015b). A total of 2,361 marine mammals were reported as fishery bycatch in 2015 in the Atlantic Region, with gray and harbor seals representing 61% of the total (NMFS 2019).

Future Baseline Conditions (Figure 3-15). Components of pelagic ecosystems—including R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS**—may be affected by a variety of stressors such as climate change, fishing, and increasing vessel traffic.

Ocean temperatures have risen more steeply over the last several decades in the North Atlantic than in many other parts of the globe (Intergovernmental Panel on Climate Change 2014). Therefore, northerly range shifts in species distribution are expected for species that are critical components of Atlantic food

webs, such as copepods (McGinty et al. 2020) and forage R.6 **FISH** (Rose 2005; Suca et al. 2021). In addition, populations of larval fishes like Atlantic cod may decline as waters continue to warm (Pershing et al. 2015).

The expected expansion of East Coast ports may result in increased vessel collisions with marine animals, which have been implicated in injuries and fatalities for several large whale species (Hill et al. 2017; Laist et al. 2014; Muirhead et al. 2018; NMFS 2006). Pelagic sharks, which aggregate and feed at fishing hot spots in the North Atlantic, would likely continue to be vulnerable to capture and mortality from longline vessels as bycatch (Quieroz et al. 2015).

Various human activities may impact North Atlantic right whales and greatly affect the remaining population (Kraus et al. 2016; Pace III et al. 2017). Increasing vessel traffic may lead to greater risk of vessel strikes, and associated vessel traffic noise may lead to acoustic masking, increased stress, and changes in migration routes (Davis et al. 2017; Parks et al. 2007; Parks et al. 2011; Rolland et al. 2012). North Atlantic right whales are particularly vulnerable to entanglement in fishing, crab, and lobster pot lines (Sharp et al. 2019). Entanglements may lead to mortality or decreased overall health due to the difficulty in foraging or swimming with additional drag from entangled gear. The stress from entanglement makes it particularly difficult for females to bear offspring and nurse their calves (Pettis et al. 2017). The effect of this stress, combined with climate-related shifts in copepod abundance (Meyer-Gutbrod and Greene 2014), may explain the lack of new right whale calves observed in 2018 (Weintraub 2018), though 19 new calves have been observed in the 2021 calving season (NOAA 2021b). Only 22 births were observed in the previous four seasons. If current stressors continue, researchers estimate that this population may be functionally extinct in the near future (Walters 2018).

2.9.3 Benthic Environment

Current Conditions (Figure 3-14). Soft bottom habitats host highly diverse R.4 **MARINE BENTHIC COMMUNITIES** of more than 160 taxa, which fluctuate in biomass and have quick colonization times. These animals (including worms, sea stars, clams, and crabs) are more numerous in finer sediments found on the outer shelf (Boesch 1979; Brooks et al. 2006; Tenore 1985); dense clam beds also exist in shallow sandy banks. Nearshore hard bottom habitats in the SECS are patchily distributed in water depths from 13 to 82 ft (4 to 25 m); these low-relief rock outcrops are colonized by worms, sponges, and algae (Continental Shelf Associates Inc 1979; Wenner et al. 1983). These hard bottom areas provide habitat for coral reefs and a variety of R.6 **FISH** and invertebrate species and serve as foraging areas for ESA-listed hawksbill R.8 **SEA TURTLES** (NMFS 2020b). Shallow “worm reefs” of sediment and colonial bristle worms in the Straits of Florida Planning Area support assemblages of algae, invertebrates, fishes, and sea turtles (Gilmore Jr. et al. 1981; Lindeman et al. 2009). Hydrocarbon seeps are present in the Atlantic Region, having first been visually verified at Blake Ridge Diapir in 1995; additional seeps have been discovered over the last decade. These seeps are home to chemosynthetic communities that form complex habitats with a variety of benthic fauna, including bacterial mats, mussels, clams, and tubeworms (Morrison 2018a).

In deeper waters (89–331 ft [27–101 m]), hard bottom habitats supporting sponges, corals, worms, and crabs account for about 25% of the shelf area (Barans and Henry Jr. 1984; Parker et al. 1983; Sedberry et

al. 2004). Scientists recently discovered coral reefs approximately 160 mi (257 km) off of Charleston, SC, at depths greater than 2,300 ft (700 m) and covering roughly 85 linear mi (137 km), providing unique deepwater habitat to a variety of R.6 **FISH** and invertebrate species (Adams 2018). The Blake Plateau and Charleston Bump are also prominent SECS features that affect hydrodynamics and attract marine species (Popenoe and Manheim 2001) (**Figure 2-14**). In the SECS, the Florida Keys NMS encompasses 2,900 mi^2 (7,511 km^2), and Gray's Reef NMS spans 22 mi^2 (57 km^2) (**Figure 2-14**). Limestone islands, sandbars, and ancient coral reefs in the Florida Keys NMS and submerged limestone hard bottom in Gray's Reef NMS support a variety of life (Halley et al. 1997; Kendall et al. 2007). Deepwater corals, such as octocorals, solitary scleractinia, and anemones, live in the Atlantic submarine canyons (Baird et al. 2017; Packer et al. 2007). The Northeast Canyons and Seamounts Marine National Monument includes four seamounts (Bear, Mytilus, Physalia, and Retriever) and three canyons (Oceanographer, Lydonia, and Gilbert) for a combined area of 4,913 mi^2 (12,725 km^2) of benthic habitat (**Figure 2-14**).

> Canyons located in the North and Mid-Atlantic Planning Areas, including the Northeast Canyons and Seamounts Marine National Monument, contain corals and hard substrate, which provide complex habitat for many marine animals and R.6 **FISHES** that attract foraging whales and sea R.7 **BIRDS**. The variety of fishes also attracts fishing vessels from throughout the Atlantic Region.

ESA-listed R.6 **FISH** species occur in the Atlantic Region benthic environment. The anadromous, ESA-listed Atlantic and shortnose sturgeon are bottom-dwelling species ranging from the South Atlantic to the North Atlantic Planning Areas. Atlantic sturgeon have critical habitat in streams where spawning occurs (NOAA 2015e; 2017a) (**Appendix D**). ESA-listed smalltooth sawfish occur in the Straits of Florida Planning Area and have coastal critical habitat (NOAA 2015f).

Economically important benthic species from the Mid-Atlantic through the Straits of Florida Planning Areas include corals, golden crab, shrimp, spiny lobster, and the snapper/grouper complex. Benthic features (e.g., live bottom) are important habitat for snapper/grouper, dolphin, and wahoo (**Appendix E**). Many of these species (e.g., hogfish and snowy grouper) are found on the bottom around reefs and structures, with ranges from coastal to open-ocean waters depending on life stage (NMFS 2019).

The North Atlantic Planning Area has a high proportion of R.6 **ESSENTIAL FISH HABITAT**. Canyons, seamounts, banks, and ledges are important fish habitat and have been identified as HAPCs for several species (New England Fishery Management Council 2017). Commercially and recreationally important species found in both the North Atlantic and Mid-Atlantic Planning Areas include scup, black sea bass, summer flounder, tilefish, surfclams, and quahogs (NMFS 2018f). Sea scallops, another important R.10 **COMMERCIAL & RECREATIONAL FISHERY**, are also found in these planning areas. Certain species like Atlantic cod gather in high concentrations to spawn and exhibit high site fidelity from year to year (Skjæraasen et al. 2011), a behavior that has been exploited by fisheries.

Warming ocean temperatures in the Atlantic Region have been correlated with changes to important marine benthic species (Pinsky et al. 2013). Twenty-four of 36 selected R.6 **FISH** species managed in the

northeast region (including Atlantic halibut and yellowtail flounder) are shifting their ranges north or moving into deeper water (Nye et al. 2009). The distribution of the commercially important surfclam has shifted toward deeper waters in response to warmer temperatures, likely due to thermal stress (Weinberg 2005). In addition to distribution shifts of native fishes, the invasive lionfish has been found around Atlantic reefs, and its range is spreading northward.

Future Baseline Conditions (Figure 3-15). Seafloor resources, including R.4 **MARINE BENTHIC COMMUNITIES** and R.6 **FISH & ESSENTIAL FISH HABITAT**, may be affected by a variety of stressors, including climate change, fishing, renewable energy development, and marine mineral activities. Climate change models show a high likelihood of extinction of local species by 2050, with species invasion and replacements also occurring but less prominent (Cheung et al. 2009). Given the rapid rate of Atlantic Ocean warming predicted in the coming century (Intergovernmental Panel on Climate Change 2018), animal range shifts may become more commonplace in the future. As ranges for marine invertebrates and fishes in the Atlantic move, contract, or expand, novel interactions among predator-prey combinations and competitors would likely affect the long-term success of individual species and marine benthic communities.

Bottom disturbance activities are expected to continue and may impact R.4 **MARINE BENTHIC COMMUNITIES**, though regulated activities are often required to avoid sensitive areas, especially in areas with special protections (e.g., Northeast Canyons and Seamounts Marine National Monument). Renewable energy development and marine minerals dredging are expected to continue or increase, which may disturb benthic habitat and associated fauna. In addition, fishing activity is expected to remain near the current rate in the SECS and possibly decline in the NECS, which may influence changes to the benthic environment. Climate change and fishing also would likely continue to impact warm-water corals (like those found in Gray's Reef NMS), and a variety of stressors may affect less-studied Atlantic cold-water corals (Roberts et al. 2006).

2.9.4 Coastal Environment

Current Conditions (Figure 3-14). Barrier islands, beaches, tidal flats, rocky shores, tidal rivers, wetlands, marshes, and SAV are common R.5 **COASTAL & ESTUARINE HABITATS** found in both the NECS and SECS Ecoregions of the Atlantic. Barrier islands protect the mainland from wave and current action, particularly during major storms and hurricanes (Oertel 1985; Rosati 2009; Zinnert et al. 2019). Beaches on the mainland and islands provide vital habitats for migratory R.7 **BIRDS** using the Atlantic Flyway, nesting habitat for R.8 **SEA TURTLES** (mainly SECS Ecoregion), and haul-out areas for seals (mainly NECS Ecoregion) (Whitney 2014). Beaches also provide habitat for shellfish and other burrowing organisms. Various beach grasses and dune vegetation provide shade, cover, food, and nesting habitat for animals.

Estuaries, tidal rivers, marshes, and stream habitats along the Atlantic Coast support a wide variety of aquatic, estuarine, and marine communities, including habitat and nursery areas for juvenile R.6 **FISH**, shellfish, R.7 **BIRDS**, and other wildlife. Extensive tidal marshes typically exist on the shoreward side of the Atlantic Coast barrier islands. The Chesapeake Bay, a key coastal habitat near the Mid-Atlantic Planning Area, supports the largest population of Atlantic blue crabs and their valuable R.10 **COMMERCIAL & RECREATIONAL FISHERY** (NMFS 2021b). Eastern oyster populations contribute to

the integrity and functionality of estuarine ecosystems by reducing suspended sediment and recycling nutrients in the water column (Eastern Oyster Biological Review Team 2007). In addition, these coastal and estuarine habitats support the American horseshoe crab, which is harvested as bait for other fisheries and by the biomedical industry (Smith et al. 2017a). Horseshoe crab eggs are an important food item of the ESA-listed red knot during the birds' spring migrations (Smith et al. 2017a).

> Seagrasses are important SAV occurring along the Atlantic Coast (except off South Carolina and Georgia), typically on the sound (landward) side of the barrier islands and in estuaries, particularly in Virginia and North Carolina. They tend to occur as patchy or continuous beds in shallow, subtidal, or intertidal unconsolidated sediments in areas with good water clarity. They form highly productive ecosystems, providing water filtration, shoreline erosion protection, and nursery habitat for many R.6 **FISH** and shellfish species. Common seagrass species include eelgrass, widgeongrass, and shoalweed. Seagrass beds have declined worldwide and face potential threats from bottom disturbance activities, die-off events, climate change, and eutrophication (Waycott et al. 2009).

Atlantic salmon R.6 **ESSENTIAL FISH HABITAT** occurs in 30 freshwater, coastal, and brackish areas from Maine to Connecticut; of these, 11 Maine rivers have been designated as HAPCs. The Gulf of Maine DPS of Atlantic salmon is ESA-listed and protected from commercial fishing (New England Fishery Management Council 2017). Additionally, coastal Maine includes designated Atlantic salmon critical habitat. In the North Atlantic and Mid-Atlantic Planning Areas, two bay systems have been identified as important habitat for sand tiger sharks (NMFS 2017). Many ecologically and economically important fish species (such as Atlantic menhaden, Jonah crab, and spotted seatrout) are managed in coastal waters. States often designate protection for R.5 **COASTAL & ESTUARINE HABITATS** (such as nursery grounds) for management and conservation purposes.

Gray and harbor seals frequent the coastal areas of the NECS Ecoregion. These R.9 **MARINE MAMMALS** usually occur closer to shore—feeding on fish, crustaceans, and squid—and haul out to rest on beaches, rocks, and man-made structures (Bowen 2016; Lowry 2016). The ESA-listed Florida subspecies of the West Indian manatee can be found in the SECS Ecoregion (Deutsch et al. 2008).

Many species of ESA-listed R.8 **SEA TURTLES** nest along sandy beaches in the SECS Ecoregion. For example, the Northwest Atlantic DPS of loggerhead nests extensively in Florida, with more sporadic nesting as far north as Virginia (NOAA 2017d). Additionally, leatherback turtles have minor nesting colonies in southeast Florida (NOAA 2016d).

Numerous species of resident and migratory R.7 **BIRDS** occur in the Atlantic Region, and many of these species use large swaths of coastal and marine habitats (Nisbet et al. 2013; White and Veit 2020). Bird species likely to be impacted by OCS activities include seabirds (gulls and terns, cormorants, frigatebirds, northern gannets, boobies, tropicbirds, petrels, shearwaters), waterfowl (loons, grebes, sea ducks), shorebirds (sandpipers, plovers, oystercatchers, stilts), and wetland birds (egrets, herons, wood storks, ibises, roseate spoonbills, cranes, rails). Five ESA-listed marine and coastal bird species occur in this region: Bermuda petrel, red knot, roseate tern, wood stork, and piping plover.

Migrating birds use the Atlantic Flyway, which spans from the Caribbean to the Arctic and covers the entire Atlantic Region. Coastal habitats serve as critical stopover areas for migratory birds to feed and rest; other species use specific coastal areas for nesting. For example, Great Gull Island off New York holds the largest concentration of nesting common terns in the world, and the shores of Long Island provide nesting habitat for 20% of the entire Atlantic piping plover population (FWS 2017; Hays 2011). The ESA-listed roseate tern mainly breeds from eastern Long Island to Cape Cod (Nisbet et al. 2013). In addition to the Atlantic Flyway, several shorebird species migrate over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles and continuing on to South America (Rappole 1995).

Future Baseline Conditions (Figure 3-15). The impacts on the coastal environment from ongoing stressors—such as climate change, shipping traffic, pollution, marine mineral extraction, renewable energy, and coastal development—are expected to continue in the coming years. For example, an increase in storms and sea level rise may inundate and damage R.5 **COASTAL & ESTUARINE HABITATS**, impacting coastal R.7 **BIRDS** and nesting R.8 **SEA TURTLES**, especially on barrier islands (Von Holle et al. 2019). The Mid-Atlantic Planning Area has experienced more sea level rise than the global mean, and this rate may be increasing (Sallenger Jr. et al. 2012; Titus et al. 2009). If barrier islands continue to diminish, beach nourishment activities may increase turbidity of nearshore waters and species entrainment, especially of ESA-listed sea turtles, which tend to spend time near the seafloor, where sands are removed to be used in beach nourishment. Warming temperatures, eutrophication, and ocean acidification could combine to create inhospitable areas in Atlantic estuaries (such as the Chesapeake Bay) and may have adverse consequences for regional R.6 **FISH** and R10 **COMMERCIAL & RECREATIONAL FISHERIES** (Keppel et al. 2016; Miller et al. 2016). Keystone species have faced recent challenges due to habitat loss and disease (e.g., the decline in the eastern oyster population) (Eastern Oyster Biological Review Team 2007). Several ports (e.g., Boston, MA; Charleston, SC; Jacksonville, FL) are expanding to accommodate megaships (Guillot 2017; Wang and Pagano 2015), and construction may lead to habitat degradation and increased noise levels in nearby areas. Finally, expected increases in tourism may affect the coastal environment with more pollution, coastal development, and recreational fishing in the future.

2.9.5 Human Environment

Current Conditions (Figure 3-14). The Atlantic Coast has a mixture of highly developed urban areas, suburban sprawl, small towns, recreational areas, and undeveloped rural lands. The Atlantic states have pockets of densely populated areas and higher levels of employment and income in metropolitan areas along the coast. In 2019, the ocean economy employed nearly 1.6 million people, bringing in nearly $125 billion in GDP (NOAA and Office for Coastal Management 2022). Overall, R.15 **RECREATION & TOURISM** is the most important sector of the ocean economy in the Atlantic Region, providing the majority of employment and GDP (NOAA and Office for Coastal Management 2019b).

The Atlantic Region is home to some of the most economically important R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in the U.S., sustaining the livelihoods of thousands of fishermen and their families, and providing a way of life for coastal communities. The Atlantic Region accounted for approximately $2 billion of the total $5.4 billion domestic commercial landings revenue in 2018, 74% of

which was generated by five New England states: Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island (NMFS 2021b). American lobster, sea scallop, and blue crab are some of the Atlantic's most economically important commercial fisheries (NMFS 2021b). In 2018, Massachusetts' commercial fisheries generated the largest employment in the region. Recreational fishermen took over 129 million fishing trips in the Atlantic Region in 2018. Eastern Florida generated the greatest employment from recreational fisheries in the region, providing over 55,000 jobs (NMFS 2021b). Popular Atlantic Region sport fishing species include snappers, drums, bluefish, black sea bass, flatfish, scup, striped bass, and wrasses.

The Atlantic Region contains many R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**, both onshore and offshore, including over 11,000 shipwrecks (TRC Environmental Corporation 2012). The Outer Banks of North Carolina is often referred to as the "Graveyard of the Atlantic," due to the many shipwrecks that have occurred in the shoals, currents, and barrier islands of this area (NOAA 2017e). The wreck site of the USS *Monitor*, a civil war-era ship, is currently an NMS off Cape Hatteras, NC. Shipwrecks are one of the most abundant types of artificial reef habitat in the North Atlantic (Steimle and Zetlin 2000), serving as a R.15 **RECREATION & TOURISM** attraction for scuba diving and creating habitat for R.4 **MARINE BENTHIC COMMUNITIES**. Native American Tribal communities along the Atlantic Coast, as well as communities that were relocated west during the 19th century, have interests in cultural resources located within their traditional lands and offshore due to their historical ties to the marine environment.

With respect to R.12 **LAND USE**, the coastal counties along the Atlantic contain densely populated urban and suburban areas, as well as many ports (Kiln 2016) and shipyards (Bureau of Transportation Statistics 2012; Dismukes 2014). Five out of 10 of the Nation's largest metropolitan areas and four of the Nation's top 25 ports by tonnage are located along the Atlantic Coast (Bureau of Transportation Statistics 2018). Numerous protected areas are also located on the Atlantic Coast, including 7 national seashores, 2 national parks, 2 national recreation areas, 10 national monuments, and 8 national historical sites and parks. NASA operates rocket testing and launches from the Goddard Space Flight Center's Wallops Flight Facility on the eastern shore of Virginia; designated downrange danger zones and patterns for debris from field tests are located within the Mid-Atlantic Planning Area.

No offshore oil and gas development or production currently occurs in the Atlantic Region. In addition, most Atlantic states do not have substantial onshore oil and gas industries. Under BOEM's Marine Minerals Program, parts of the Atlantic OCS are dredged for sand used to address erosion along beaches and to strengthen the resilience of coastal communities and infrastructure (BOEM 2018d).

Figure 3-5. Alaska Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

IPFs may impact Alaskan resources in unique ways because of the region's remoteness and limited development. For example, subsistence (**R.13, R.14**) food sources are vital to many parts of the Alaska Region. Sound sources associated with oil and gas (**I.1**) may disturb fish (**R.6**) and marine mammals (**R.9**). Increased noise (**I.1**) may displace bowhead whales (**R.9**) or other mammals (e.g., caribou [**R.5**]) central to subsistence hunts, changing harvest patterns and success and adversely affecting food security, sense of well-being, and cultural identity of Alaska Native peoples (**R.13, R.14**). Noise (**I.1**) and visible infrastructure (**I.7**) associated with offshore and onshore construction may also impact culture (**R.13**), vulnerable coastal communities (**R.14**), and tourism and recreation (**R.15**). Some localized routine discharges, such as drilling muds and cuttings (**I.3**), may degrade benthic communities (**R.4**) and impact key feeding grounds for certain birds and marine mammal species (such as walrus) (**R.9**) that feed on benthic organisms. Disturbance (**I.4**) from pipeline laying, anchoring, offshore construction, and other activities may degrade or destroy sensitive benthic communities (**R.4**). Onshore construction may permanently alter wetlands and other coastal habitats (**R.5**), displacing birds (**R.7**) and other animals (e.g., caribou). Lighting (**I.6**) on new infrastructure may disorient migrating birds (**R.7**). Waves from increased vessel traffic (**I.2**), especially near industrial areas such as ports, may increase shoreline (**R.5**) erosion. Land use (**R.12**) in remote areas may be intensified dramatically by onshore industry-support construction and traffic (**I.2**) because of limited existing highway and road systems. Oil and gas activities may also cause space-use conflicts (**I.8**) with the Alaska fishing industry (**R.10**), subsistence users (**R.13, R.14**), or other Federal activities (**A.10**), such as NASA launch operations.

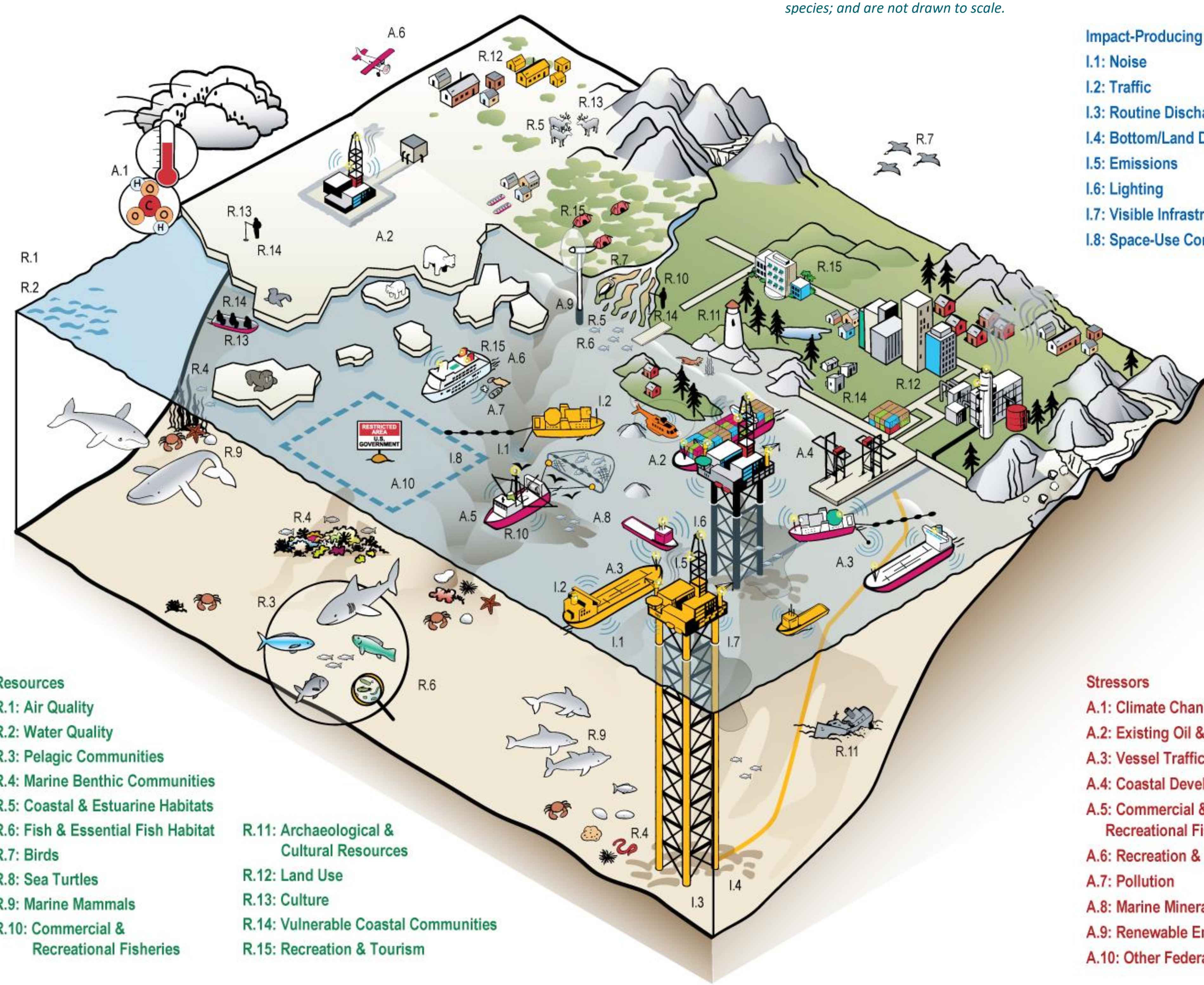


Figure 3-9. Pacific Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

Noise (**I.1**) may injure or disturb fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**). Some communities (**R.14**) may be disrupted by visible infrastructure (**I.7**) or noise (**I.1**) from onshore facilities. New industrial facilities may be required and influence land use (**R.12**). Vessel traffic (**I.2**) may make waves and increase erosion; onshore construction (**I.4**) may degrade coastal and estuarine habitats (**R.5**). Localized drilling muds, cuttings, and debris (**I.3**) may reduce water quality (**R.2**) and smother, alter, or remove benthic communities (**R.4**), which is a particular concern for sensitive areas such as cold-water coral reefs and kelp beds. In areas characterized by relatively undeveloped seascapes and coastlines, visible infrastructure (**I.7**), noise (**I.1**), and lighting (**I.6**) may impact recreation and tourism (**R.15**) and cultural practices (**R.13**) dependent upon wilderness characteristics. Increased vessel traffic (**I.2**) and emissions (**I.5**) from new facilities may contribute to existing exceedances of the NAAQS in southern California (**R.1**) and potentially affect vulnerable coastal communities (**R.14**). Oil and gas activities may cause space-use conflicts (**I.8**) with other human uses of the OCS, including commercial and recreational fishing (**R.10, A.5**) or other Federal activities (**A.10**), such as military operations or offshore renewable energy development (**A.9**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

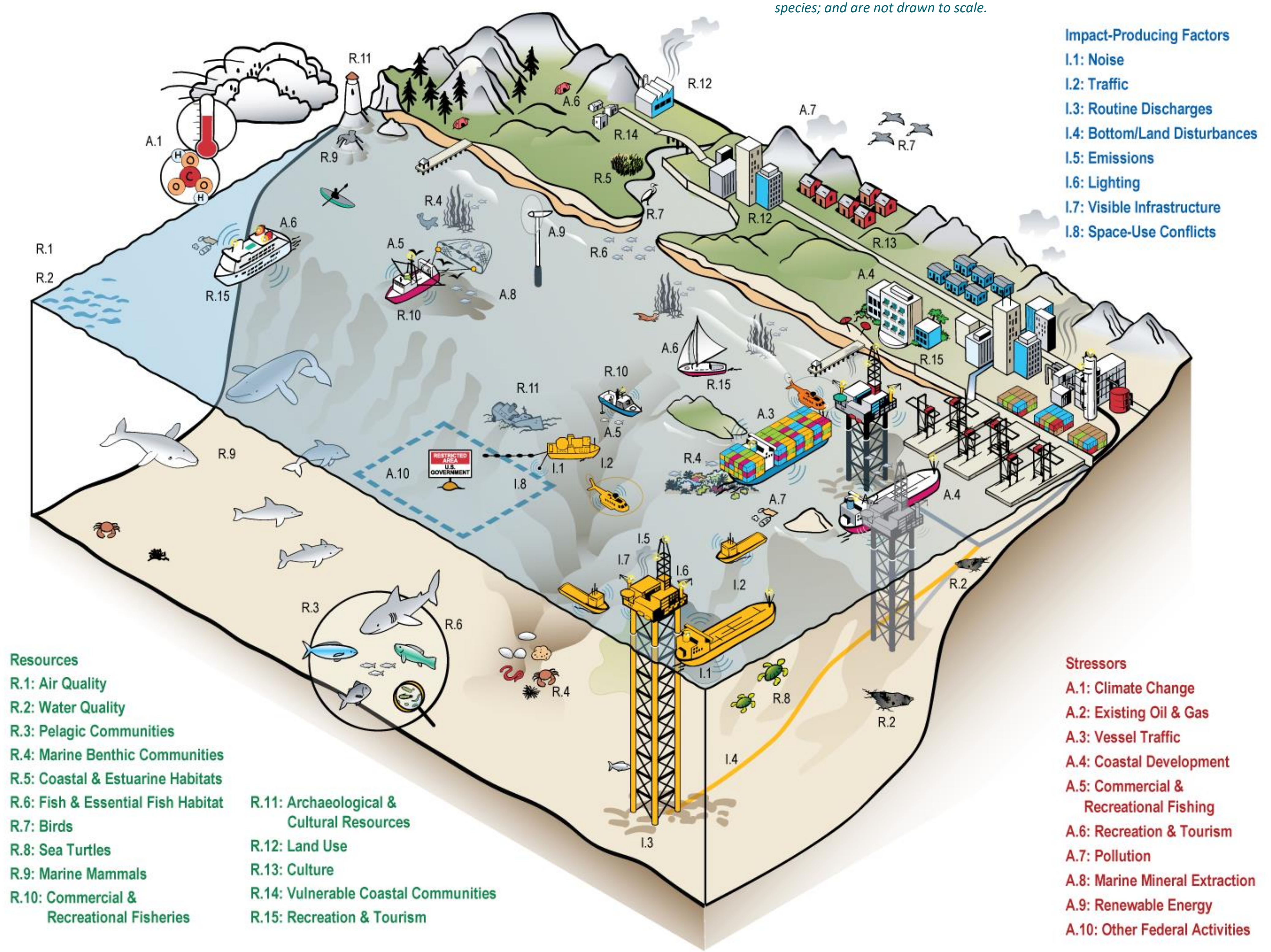


Figure 3-12. Gulf of Mexico Region—Potential Impacts of Alternative A—No Action Alternative (No Leasing)

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.2.1** for additional discussion.*

Oil tankering (**A.3**) may increase if current energy consumption patterns continue and, if so, likely would be the most notable change, impacting fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**), particularly due to discharges and vessel noise. Vessel strikes (**A.3**) to mammals (**R.9**) and sea turtles (**R.8**) may also increase. Dredging to support new or expanded routes for tanker traffic may damage marine benthic communities (**R.4**) and injure or kill sea turtles (**R.8**). Oil spills from tankers may have significant long-term and population-level effects on marine resources (**R.2–R.10**), as well as culture (**R.13**), vulnerable coastal communities (**R.14**), and recreation and tourism (**R.15**). The economic impacts of no leasing would create losses associated with employment, income, and revenues, which could also have impacts on culture (**R.13**) and vulnerable coastal communities (**R.14**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

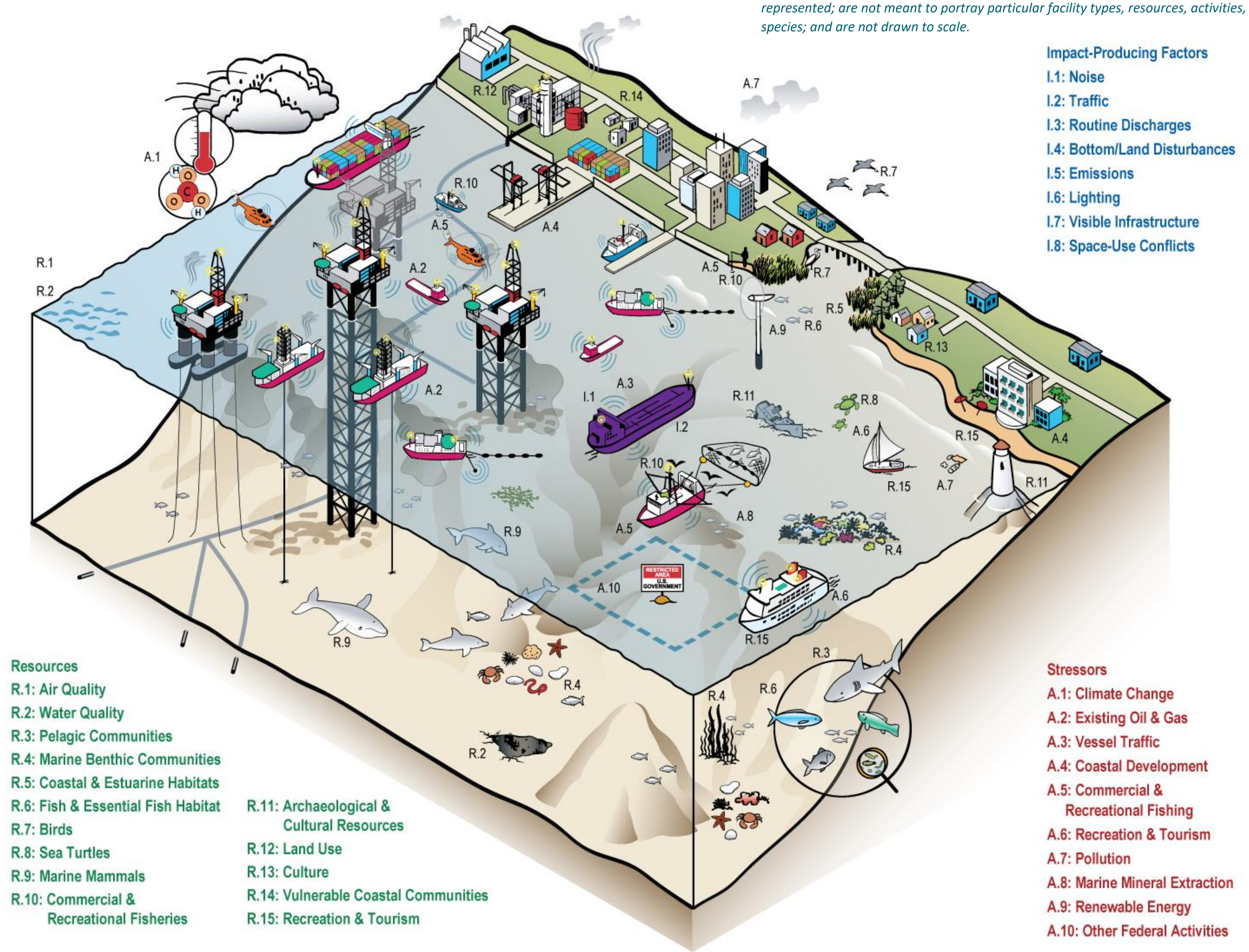


Figure 3-13. Gulf of Mexico Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

Oil and gas activities are expected to continue at existing levels in shallow and deeper waters. Fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**) may be injured or disturbed by noise (**I.1**) associated with oil and gas development. Vessel activity (**I.2**) (such as tanker and barge transport, survey vessel trips, and support vessels) may impact sea turtles (**R.8**), marine mammals (**R.9**), and coastal and estuarine habitats (**R.5**). Drilling mud and cutting discharges (**I.3**) may smother local marine benthic communities (**R.4**), which may also be impacted by pipeline laying, anchoring, and platform construction (**I.4**). Port infrastructure may need to be expanded (**I.4**) in undeveloped areas to accommodate increased offshore oil and gas development and associated support activities. Loss of coastal habitats (**I.4**) may impact migratory and coastal bird species (**R.7**) that use these areas for nesting, foraging, and migration. Lighting (**I.6**) on structures and vessels may impact birds (**R.7**). Water and land traffic (**I.2**) may increase to support OCS development and onshore support infrastructure. Culture (**R.13**) and vulnerable communities (**R.14**) may experience long-term impacts from traffic (**I.2**), visible infrastructure (**I.7**), and noise (**I.1**), especially in the Eastern GOM Planning Area. Increased vessel and offshore emissions (**I.5**) may further degrade air quality (**R.1**) for O_3 in nonattainment areas and Class I areas. Oil and gas activities may cause space-use conflicts (**I.8**) with other human uses of the OCS, including commercial and recreational fishing (**R.10, A.5**) or other Federal activities (**A.10**), such as military operations or marine mineral extraction (**A.8**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

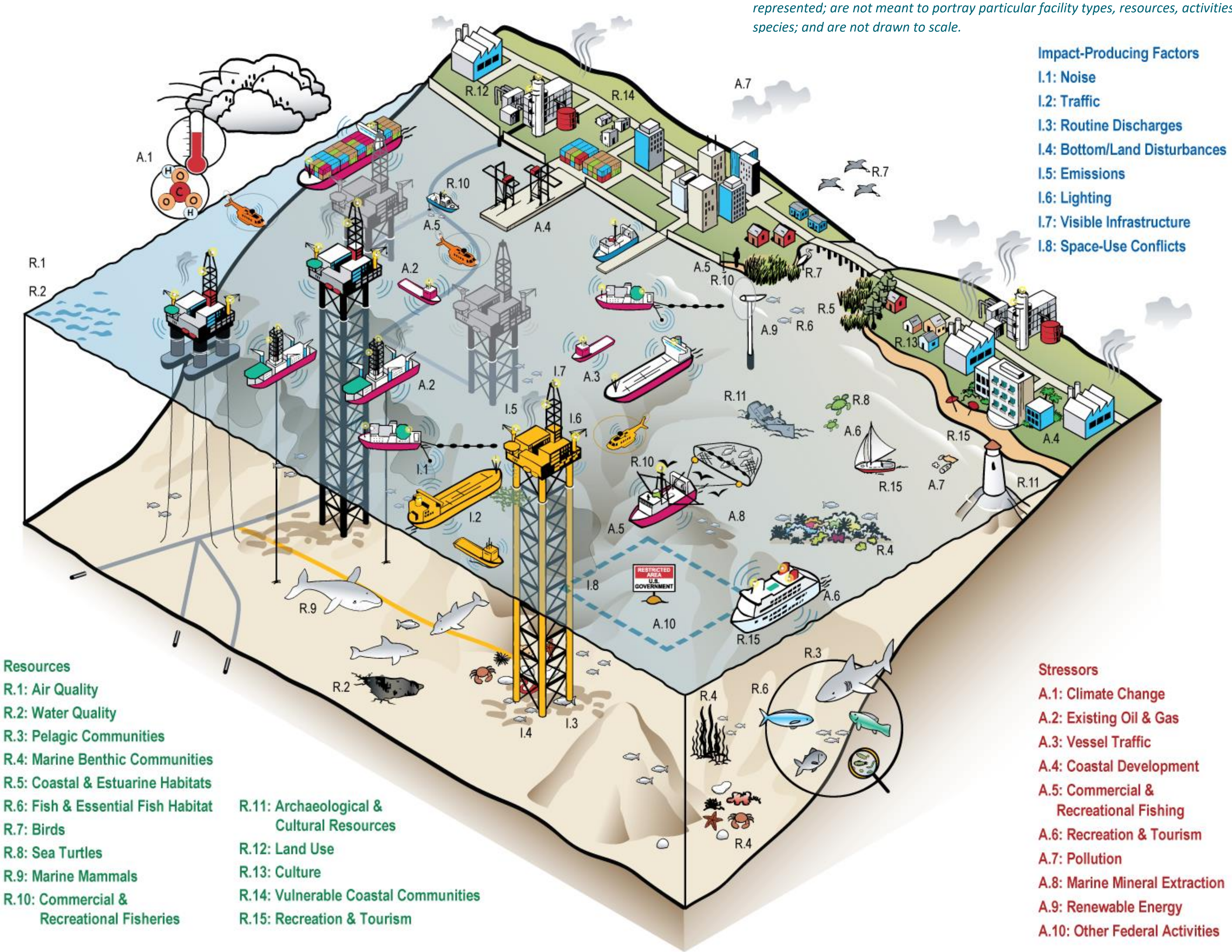
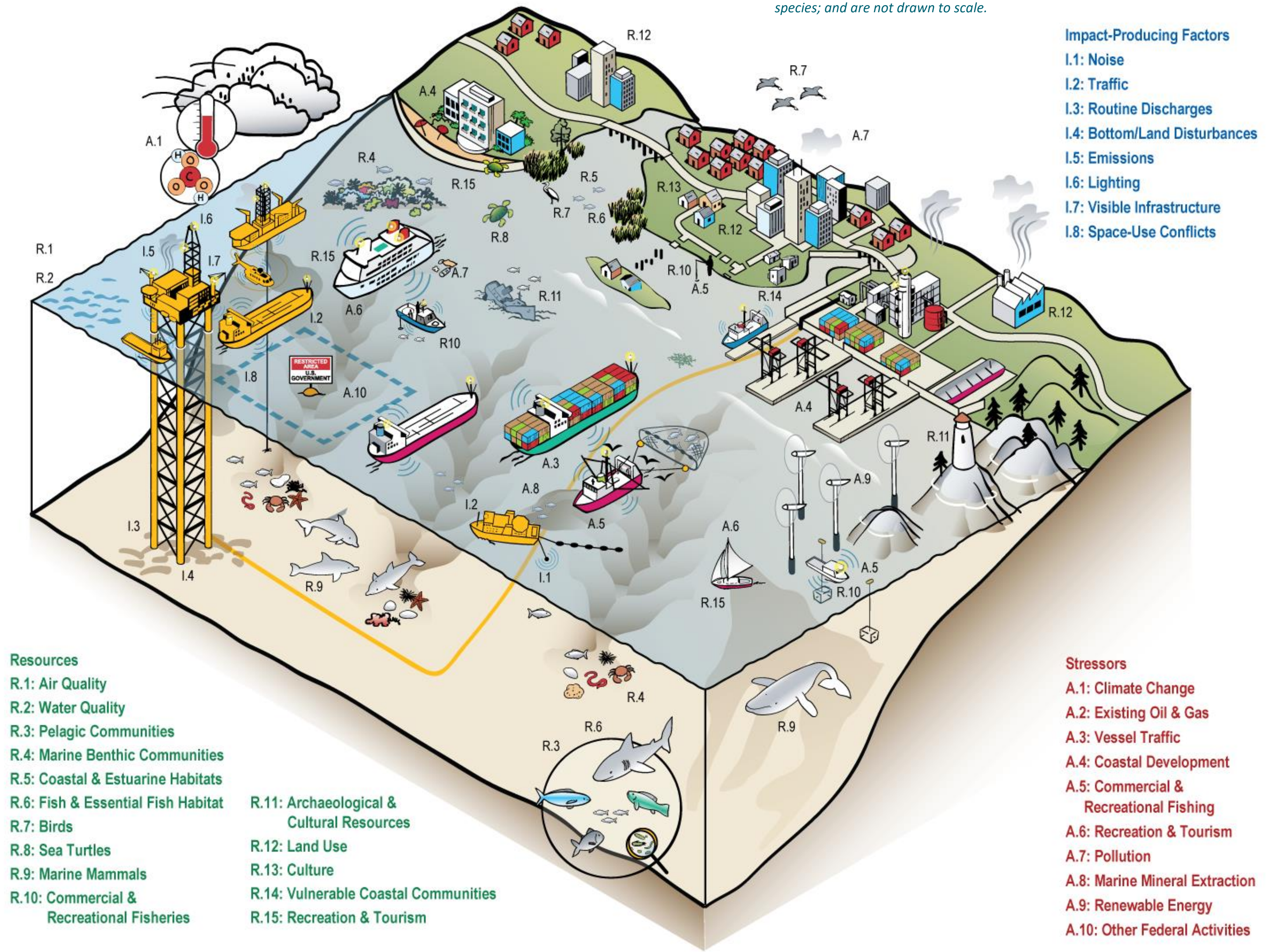


Figure 3-17. Atlantic Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

Noise (**I.1**) associated with oil and gas activities may injure or disturb the behavior of fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**). Noise (**I.1**) from new construction to support offshore oil and gas development may also be noticeable to coastal residents living nearby (**R.14**). The barrier islands and beaches (**R.5**) in the southeast may be particularly susceptible to increased erosion caused by vessel activity (**I.2**), which may also impact recreation and tourism (**R.15**) if beaches become inaccessible or change in character. Additional vessel traffic (**I.2**) may increase strikes of sea turtles (**R.8**) and whales (**R.9**), such as the ESA-listed North Atlantic right whale. Although localized, drilling muds and cuttings (**I.3**) may degrade benthic communities (**R.4**), such as those in the northeast canyons or hard bottom areas along the southeast Atlantic Coast. Disturbance (**I.4**) from pipeline laying, anchoring, offshore construction, and other activities may stress benthic communities (**R.4**) and coastal and estuarine habitats (**R.5**). To accommodate offshore development, land use (**R.12**) may change through expansion of existing oil and gas support infrastructure (e.g., ports, shipyards, support vessels). Construction (**I.4**), lighting (**I.6**), and physical presence (**I.7**) of these facilities may impact coastal and estuarine habitats (**R.5**), which in turn may affect coastal and migratory birds (**R.7**), estuarine fish (**R.6**), and nesting sea turtles (**R.8**). Visible infrastructure (**I.7**) could impact people's use or enjoyment of coastal views (**R.13, R.14, R.15**). Increased construction may augment congestion on local roadways (**R.12**). Oil and gas activities may cause space-use conflicts (**I.8**) with the Atlantic fishing industry (**R.10, A.5**), offshore renewable energy development (**A.9**), and Federal activities (**A.10**), such as military training, NASA launch operations, and marine mineral extraction (**A.8**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.



amenities. Furthermore, the addition of visible infrastructure may affect property values or the visual aspects of environmental quality surrounding existing public services, such as community recreation facilities.

R.15 **RECREATION & TOURISM:** Visible infrastructure may impact recreation and tourism in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Impacts may be higher in areas where visitors are drawn to the unique wilderness character, undisturbed ocean views, and low level of industrial infrastructure and activity (Dean Runyan Associates 2017a; Dussault 2016; Outdoor Industry Association 2017; Washington Tourism Alliance 2017). Natural ocean views that draw beachgoers and recreationists may be impacted by industrialization (BOEM 2018a; Li 2009). Visible infrastructure, or the perception of industrial activity, could degrade the quality of the recreational experience and adversely affect recreation or nature-based tourism (Brody et al. 2006). Overall, an industrialized viewshed from oil and gas activities onshore and nearshore may affect visitor experience (Li 2009; Visit Florida 2018). Visible infrastructure impacts may be greater in locations where people recreate more often, in popular tourist destinations, or in areas dependent on recreation and tourism revenues.

I.8 SPACE-USE CONFLICTS

R.10 **COMMERCIAL & RECREATIONAL FISHERIES:** Space-use conflicts are potentially significant for commercial and recreational fisheries in all planning areas where offshore facilities and activities could limit access to fishing grounds, either temporarily or for the life of a platform (Arbo and Thủy 2016; Arne 2012). These areas include the Alaska Region (except the Beaufort Sea and Chukchi Sea Planning Areas), Pacific Region, GOM Region, and Atlantic Region. Many commercial and recreational fishermen rely on specific offshore areas important to catch target species (Island Institute 2012). Exclusion from a highly productive area may decrease landings or cause longer trips (Arbo and Thủy 2016), resulting in decreased revenue. The extent of the impact from space-use conflicts would depend on the timing and location of activities. Areas with existing oil and gas activity have more experience coordinating with fishing industries and may be able to decrease space-use conflicts more effectively than areas with less experience.

R.12 **LAND USE:** Space-use conflicts may impact land use in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Uses of the OCS (e.g., military, subsistence, or renewable energy development) may be impacted by spatial or temporal conflicts among users (GSA 2018; Mid-Atlantic Regional Council on the Ocean 2020a; Northeast Regional Ocean Council 2018). For example, OCS oil and gas activities may affect Federal uses of the OCS, such as offshore military exercises or space launch activities. Potential conflicts may also arise with overlapping onshore uses, such as new onshore construction operations and land use plan changes. In some cases, conflicts may be avoided or minimized through mitigation measures, such as coordination and time or area closures.

R.13 **CULTURE:** Space-use conflicts are potentially significant for culture in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts may impact the culture of small, coastal fishing communities, as well as Tribal communities, because their cultural identity is strongly linked to fishing. Vessel traffic or oil and gas facilities may impact the culture of those

communities by interfering with the sustainable harvest, transport, sale, processing, or storage of fish, or threatening fisheries sustainability. The arrival of field crews and oil workers conducting related land-based operations may interfere with subsistence hunting and fishing activities (Stephen R. Braund & Associates 2010; 2017), which may impact these important cultural practices. Impacts on food resources may cause adverse impacts on nutrition, sense of well-being, community resilience, and cultural identity (Kofinas et al. 2015).

R.14 **VULNERABLE COASTAL COMMUNITIES:** Space-use conflicts are potentially significant for vulnerable coastal communities in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts nearshore and offshore may have adverse or disproportionate impacts on community subsistence and other non-industrial uses (Sandlos and Keeling 2016). Leasing may adversely impact food security, nutrition, sense of well-being, community resilience, and cultural identity, and may disproportionately impact Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015). New onshore facilities may be situated near or within communities that have been historically underserved and live in closest proximity to industrial zones (Maantay 2002b). Low-income communities may be particularly subject to further industrialization, which may create space-use conflicts.

R.15 **RECREATION & TOURISM:** Space-use conflicts may impact recreation and tourism in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts may occur, particularly in remote wilderness areas, where recreational activities rely on undeveloped natural land and seascapes (Brody et al. 2006; Li 2009). The occurrence of onshore and offshore OCS oil and gas activities may adversely affect the quality of visitor experiences and ultimately deter tourism (Klenosky et al. 2007). Recreation and tourism industry declines may have a negative effect on state GDP (Harcombe 1999).

I.1 NOISE—See **Appendix B** for a general description of the impacts of noise.

R.6 FISH & ESSENTIAL FISH HABITAT: Noise is potentially significant for fish and EFH in all GOM planning areas. Fish with swim bladders—such as snappers, jacks, groupers, cobia, and tunas—may be susceptible to injury when close to high-energy sources like seismic airguns or explosive decommissioning. Behavioral impacts from noise are more likely than injury or mortality and may also be more widespread. An in situ study on Atlantic bluefin tuna showed that vessel noise may disorient fish and change schooling dynamics (Sarà et al. 2007). Therefore, noise may temporarily disrupt normal behaviors in this species, which spawns throughout the GOM Region (Teo et al. 2007). Several sound-producing fishes inhabit parts of the GOM (Wall et al. 2013), including commercially important species such as red drum, red snapper, and grouper. Most of these species are sensitive to low-frequency sound and use acoustic signals to coordinate spawning (Locascio and Burton 2015; Mann et al. 2009; Montie et al. 2016; Nelson et al. 2011). Noise may cause masking or disruption of important behaviors; however, impacts are dependent upon proximity to the sound source, signal characteristics, and whether the noise co-occurs with reproductive activity.

R.8 SEA TURTLES: Noise is potentially significant for sea turtles in all GOM planning areas. Seismic activity may impact both breeding and hatchling Kemp's ridley sea turtles, which occur in all GOM planning areas. Soon after hatching, Kemps' ridley sea turtles swim into the open ocean and drift with floating *Sargassum* patches (FWS 2015). Although adult turtles would probably swim away from approaching seismic vessels and only experience behavioral disturbance (DeRuiter and Larbi Doukara 2012), younger and slower turtles may struggle with avoidance (BOEM 2014).

R.9 MARINE MAMMALS: Noise is potentially significant for marine mammals in all GOM planning areas. Disturbance from noise in the Eastern GOM Planning Area has the potential for greater impacts than in other GOM planning areas because of the lack of existing oil and gas activity there. Populations of sperm whales and beaked whales are expected to be most susceptible to auditory injury or behavioral disturbance from deep-penetration seismic surveys (BOEM 2017d; Farmer et al. 2018). As described in **Section 2.8**, the Rice's whale population is found in the Eastern GOM Planning Area and may be impacted by increased noise from vessels or seismic airguns in this area (Estabrook et al. 2016; Putland et al. 2018). Manatees spend most of their time near coastlines and have greatest hearing sensitivity in higher frequencies (Gaspard III et al. 2012), so they may be less affected by airgun noise. Several distinct populations of resident bottlenose dolphins live along the western and northern coasts of Florida (Van Parijs 2015) and may experience behavioral disturbance from noise when they venture farther from the coast.

> Several species of baleen and toothed whales in all GOM planning areas may experience behavioral disturbance from noise, particularly noise generated by seismic airguns or vessels. When in very close proximity to airguns, it is possible that auditory injury could also occur. For a detailed analysis of potential impacts, see the GOM G&G Programmatic EIS (BOEM 2017d).

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Noise is potentially significant for culture and vulnerable coastal communities in the Eastern GOM Planning Area because, in contrast to the well-developed Western and Central GOM Planning Areas, new development may be required if the necessary facilities do not yet exist. High densities of low-income communities and minority populations are more prevalent near ports (i.e., industrialized areas) within these planning areas. Increased noise from construction, port staging, and increased vessel traffic may disproportionately impact these vulnerable coastal communities near industrial zones in the Eastern GOM Planning Area (Maantay et al. 2010; USEPA 2018e). Onshore noise at ports and other facilities that serve the Western and Central GOM Planning Areas, or facilities near the Western and Central GOM Planning Areas used as a base for activity in the Eastern GOM Planning Area, may extend existing noise-related impacts on nearby communities but would likely represent a continuation of baseline noise levels.

R.15 **RECREATION & TOURISM:** Noise is potentially significant for recreation and tourism in the Eastern GOM Planning Area. The difference in existing industrialization and oil and gas activity between the Western and Central GOM and the Eastern GOM Ecoregions drives many of the differences in potential impacts on recreation and tourism. Because Florida is so reliant on its recreation and tourism industry, any negative impacts (e.g., nearshore and onshore noise from oil and gas support industry vessels, shipyards) associated with OCS oil and gas activities may deter visitors and negatively affect Florida's economy.

I.2 TRAFFIC

R.5 **COASTAL & ESTUARINE HABITATS:** Traffic is potentially significant for coastal and estuarine habitats in all GOM planning areas. Vessel traffic (e.g., tankers, barges, support vessels, and seismic survey vessels) associated with oil and gas activities and pipeline installation may increase wave erosion and habitat disturbance.

> In all the GOM planning areas, stressors such as sea level rise, land loss, and subsidence are already placing pressure on coastal and estuarine habitats. The addition of increased vessel traffic from OCS oil and gas activities may exacerbate coastal and estuarine habitat loss.

R.7 **BIRDS:** Traffic is potentially significant for birds in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 **SEA TURTLES:** Traffic is potentially significant for sea turtles in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.9 **MARINE MAMMALS:** Traffic is potentially significant for marine mammals in all GOM planning areas. Rice's whales spend 90% of their time within 39 ft (12 m) of the ocean's surface (Constantine et al. 2015), which makes them vulnerable to collisions with large ships. Manatees are slow moving and are often struck by smaller boats (FWS 2001). Increased vessel activity along the coast may put both species at risk, especially in the Eastern GOM Planning Area, where Rice's whales reside and where manatees

4.4.2 Pacific Region

There are five 12(a) withdrawal areas in the Pacific Region: Olympic Coast NMS in the Washington/Oregon Planning Area; Greater Farallones, Cordell Bank, and Monterey Bay NMSs, which fall almost entirely inside the Central California Planning Area; and Channel Islands NMS in the Southern California Planning Area (**Figure 4-14**). These areas are withdrawn according to the boundaries in place as of 2008. Since then, the Greater Farallones (formerly Gulf of the Farallones NMS) and Cordell Bank NMSs have expanded their boundaries. While not explicitly withdrawn under Section 12(a), these areas of expansion prohibit oil and gas activities within the expanded boundaries through regulation.

There will be no new leasing under the 2024–2029 Program in withdrawn areas. Because the programmatic analyses consider resources occurring within planning areas and do not anticipate the location or intensity of potential activities, the withdrawal of the NMSs in this region would not necessarily result in notably different impacts than if the entire area were included (**Table 4-7**). Resources within a planning area could still be impacted by oil and gas activities even if portions of the planning area are unavailable for leasing. In the Central California Planning Area, NMSs run the entirety of the coastline and extend offshore to varying degrees but do not encompass the entire planning area. However, the narrow continental shelf in this area means that most of the available hydrocarbon resources are also relatively nearshore. If withdrawal of the NMSs in this area resulted in no new leasing in the entire planning areas in which they are located, impacts in those planning areas could be reduced to those presented under Alternative A (No Action Alternative).

Table 4-7. Where to find the analysis relevant to Section 12(a) withdrawals in the Pacific Region

Withdrawal Area	Planning Area-level Affected Environment & Environmental Consequences	Impacts if Withdrawn	Cross-Boundary Analysis	Cumulative Impacts Analysis
National Marine Sanctuaries (Portions of all Pacific Planning Areas)	**Section 2.5**—Overview of the Affected Environment **Section 2.7**—Pacific Region Affected Environment **Section 4.1.3**—National Overview of Impacts **Section 4.1.7**—Potentially Significant Impacts in the Pacific Region	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing) (Central California) **Section 4.2.3**—Alternative C: 9 Planning Areas (Southern California) **Section 4.2.4**—Alternative D: 25 Planning Areas (Northern California, Washington/Oregon)	**Section 4.2.3.1**—Alternative C Cross-Boundary Impacts **Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.2.2**—Cumulative Effects Expected Under Alternative D in the Pacific Region (Washington/Oregon, Northern California, Southern California) **Section 4.3.5**—Cumulative Effects Expected Under Alternative A (Central California)

A 25-nmi coastal buffer would exclude leasing and provide protection for sensitive resources within the buffer area. However, this buffer would not necessarily limit other activities (such as vessel traffic, support activities, and shore-based infrastructure) from occurring outside the buffer; these activities could still affect the resources within the buffer. **Table 4-12** shows the percentage of each planning area occupied by a 25-nmi coastal buffer. This coastal buffer overlaps with four geologic plays in the Mid-Atlantic Planning Area and does not implicate any known plays in the other Atlantic planning areas.

Biodiversity Strip

The northeast shelf off the Atlantic Coast is one of the most productive ecosystems in the world (Aquarone and Adams 2017). Beginning at about the 100-m isobath and running parallel to the Atlantic Coast are biologically rich areas with diverse assemblages of fishes, whales, deep-sea corals, and deepwater canyon habitats. Both options for the Biodiversity Strip exclusion (**Figure 4-18**) would exclude a portion of the Atlantic shelf break. The Biodiversity Strip could begin at either the 100-m or the 150-m isobath, with both options extending seaward for 30 nmi (56 km) toward the shelf break.

The biologically unique habitats within the Biodiversity Strip support some of the most productive recreational and commercial fisheries in the U.S. (Kaplan 2011). Several commercially important fishes rely heavily on this ecosystem. Pelagic species such as tuna and swordfish have been associated with canyons in the area, particularly Hudson, Baltimore, and Norfolk Canyons. Deepwater assemblages of hard corals are particularly important because they create complex habitat and have been observed in most of the canyons where hard substrate is exposed (Baird et al. 2017; CSA Ocean Sciences Inc et al. 2019). Although significant colonies of well-known corals (such as *Lophelia*) are rare within canyons, some types of corals (including black corals and sea fans) add significant community structure and support high community diversity (Baird et al. 2017). Cold-water corals are long-lived and slow-growing species; therefore, they are more susceptible to disturbance. Cold-water corals also serve as important habitat for deepwater fishes.

Deep-diving species, such as ESA-listed sperm whales, are found in greatest densities eastward of 100-m isobaths (Roberts et al. 2016). The ESA-listed fin and sei whales, as well as various beaked whales, also occur throughout the water column. Many marine mammals found in this high-density area are sensitive to mid- to low-frequency sounds (Southall et al. 2019). Some of the larger species of fish and marine mammals live many years, have low reproductive rates, grow slowly, and may be more vulnerable to impacts from oil and gas and other activities.

Both Biodiversity Strip options would provide protection to both pelagic and benthic resources, such as highly migratory fishes and deep-sea corals, from routine oil and gas impacts. Excluding the Biodiversity Strip from oil and gas activities would offer protection for important habitats and species of the Atlantic canyons and other unique features found throughout the area. The 150-m isobath is the smaller of the two options and protects the areas of highest year-round marine mammal density. The 100-m isobath option covers a larger area and includes more ESA-listed species core density area than the 150-m isobath option.

R.3 **PELAGIC COMMUNITIES** may experience cascading effects from direct contact with oil at the surface, dissolved in the water column, or entrained in sinking detritus. The *Deepwater Horizon* oil spill in the GOM was followed by loss and then recovery of *Sargassum* mats and other biological communities at the sea surface (Powers et al. 2013). A crude oil release from a wellhead (subsurface release, blowout) or from a drilling rig (surface release) may impact phytoplankton and zooplankton within an affected area. Zooplankton are especially vulnerable to acute crude oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production) (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016; Moore and Dwyer 1974; Suchanek 1993). Additionally, oil spills may be treated with dispersants to help prevent onshore contamination; however, these treatments may have their own varying effects, such as increased oil toxicity to phytoplankton (Bretherton et al. 2019) and changes in microbial community composition (Doyle et al. 2018). Reef-building corals release reproductive bundles that rise through the water column to the surface during very limited, specific time periods and are fertilized. Surface spills may impact coral spawning events if a spill occurs near a reef where spawning is occurring.

R.4 **MARINE BENTHIC COMMUNITIES** may be impacted on the seabed and along the shore. Impacts on deepwater benthic organisms are expected to be largely sublethal and may include reduced feeding and reproduction, physical tissue damage, and altered behavior. Impacts on deepwater communities may include reduced recruitment success, growth, and biological cover as a result of impaired recruitment (Kushmaro et al. 1997; Rogers 1990). Laboratory tests by DeLeo et al. (2016) on the relative effects of oil, chemical dispersants, and chemically dispersed oil mixtures on three species of northern GOM deepwater corals found much greater health declines in response to chemical dispersants and oil-dispersant mixtures than to oil-only treatments, which did not result in mortality. Some spilled oils are heavier than seawater and will sink, while other lighter oils may eventually settle on the seafloor through a binding process with suspended sediment particles (adsorption) or after aggregation, as marine snow (BOEM 2016b; Passow et al. 2012). Deepwater benthic habitats may be smothered by the sinking oil or particles and experience long-term exposure to hydrocarbons (Fisher et al. 2014; Hsing et al. 2013; Valentine and Benfield 2013). In situ burning of oil as a response activity may also introduce burn residue, which may sink to the seafloor and expose benthic organisms and communities to further oil contaminants (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016).

R.5 **COASTAL & ESTUARINE HABITATS** are especially sensitive to spilled oil. Potential impacts are complex and depend on the multiple factors listed above, including oil type, time of year in which a spill occurs, and specific habitat characteristics such as porosity. Wetlands, sheltered tidal flats, and sheltered rocky shores are particularly sensitive to oiling (Whitney 1994), with some areas remaining impacted for decades (Li and Boufadel 2010; Neff et al. 2011). Coastal wetlands may be significantly affected by toxic hydrocarbon and non-hydrocarbon spill components. Vegetated wetlands and semipermeable substrates sheltered from wave energy and strong tidal currents are the most vulnerable intertidal habitats (Hayes et al. 1992; NOAA 2017b). As volatile components are lost, oil on beaches thickens and forms tar balls, pavements, and aggregations that incorporate sand, shell, and other materials. Oil on wetlands or vegetated submerged habitats such as seagrass meadows may kill biota and cause degradation or permanent loss of habitat; plants could also recover by regenerating

new shoots (Kenworthy et al. 2017; Pezeshki and DeLaune 2015). Animals that use the habitat, especially benthic organisms that reside in the sediments and are an important component of the food web, may be impacted in turn by this habitat loss. Habitat degradation may persist and have long-term residual impacts on the community ecology, habitat structure, and function. In addition, loss of vegetation along coastal salt marshes may accelerate erosion and retreat of shorelines (Silliman et al. 2012). Lastly, shoreline cleanup efforts after a spill often can mitigate impacts from a spill but may sometimes cause additional negative impacts on the affected habitat if done improperly (Zengel et al. 2015).

R.6 **FISH & ESSENTIAL FISH HABITAT** may both be affected by exposure to spilled oil. A large spill in open waters of the OCS would likely have sublethal and indirect effects on adult fish, which can detect and avoid adverse conditions, metabolize hydrocarbons, and excrete metabolites and parent compounds. However, long-term exposure to contaminants may cause chronic sublethal effects (Baguley et al. 2015; Millemann et al. 2015; Murawski et al. 2014; Snyder et al. 2015), which could affect fish populations. Oil floating on the surface may directly contact ichthyoplankton found at or near the surface, coating eggs and larvae and exposing them to dissolved toxic compounds. Most ichthyoplankton likely would be unable to avoid spills, and affected individuals may be at risk of death, delayed development, abnormalities, endocrine disruption, or other effects resulting in decreased fitness and reduced survival rates (Brown-Peterson et al. 2015; Incardona et al. 2014; Mager et al. 2014; Snyder et al. 2015). Spills reaching nursery habitat or overlapping spatiotemporally with a spawning event have the greatest potential for affecting the early life stages of fish and invertebrates.

R.7 **BIRDS** are vulnerable to oil spills in the water and on the shoreline. Oil spills may adversely impact birds by direct contact, fouling their habitat, and contaminating their food. Eating or inhaling oil during feeding and grooming may lead to tissue and organ damage. Oil may also interfere with finding food, predator avoidance, homing by migratory species, disease resistance, growth rates, reproduction, and respiration. Oiled birds may quickly become hypothermic, lose buoyancy and ability to fly, or die from oil toxicity. Eggs, young, or adult birds exposed to oil or food contaminated with oil may experience various lethal and sublethal effects. Birds may leave fouled habitats for areas that were less suitable for them before a spill. Even a small spill may have serious impacts on ESA-listed species.

R.8 **SEA TURTLES** are affected by oil spills through pathways that include direct contact, inhalation of oil and its volatile components, and ingestion of fouled prey (Wallace et al. 2020). Oil can adhere to sea turtle skin and shells, and contact with spilled oil may decrease health, reproductive fitness, and longevity and increase vulnerability to disease and contamination of prey. Sea turtles surfacing within or near an oil spill likely would inhale petroleum vapors, causing respiratory stress. Ingested oil, particularly the lighter fractions, can be acutely toxic to sea turtles. In addition, several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, inhalation of large volumes of air before dives (Milton et al. 2010), and affinity to the *Sargassum* community, where oil can be concentrated, for food and cover (Witherington et al. 2012). Although sea turtles could nest on oiled beaches, it is likely that nesting females would abandon nesting attempts. If nesting occurs, the nesting female, hatchlings, and eggs may get oiled.

R.9 **MARINE MAMMALS** are expected to be affected primarily by larger spills. Marine mammals may be affected through pathways including direct surface contact with oil, inhalation of oil or its volatile components, direct ingestion, or ingestion of contaminated prey. These pathways may lead to decreased health, reproductive fitness, and longevity, as well as increased vulnerability to disease. An oil spill may lead to the localized reduction, disappearance, or contamination of prey species. Benthic-feeding marine mammals, including walrus and other species that feed on clams and polychaete worms, are most likely to eat oil-contaminated prey, as these benthic animals tend to concentrate petroleum hydrocarbons (Fukuyama et al. 2000; Würsig 1988). The risk is reduced for plankton-feeding baleen whales and is lowest for fish-eating marine mammals, as most petroleum hydrocarbons are not biomagnified in the food web (Würsig 1988). Protected bays and estuaries present particular risks where oil may concentrate and lead to long-term exposure (Schwacke et al. 2014). In addition, any loss of fitness, reproduction, or health may be significant in some very vulnerable species, such as the North Atlantic right whale or Rice's whale.

Cetaceans (including bowhead and beluga whales) concentrate in ice leads during spring migration (BOEM 2012b). In the Alaska Region, an oil spill during periods of restricted open water due to ice cover may have severe effects, as animals are limited in their ability to avoid the oil. Impacts on marine mammal calving grounds may lead to population-level effects. Pinnipeds and polar bears may be exposed when coming ashore onto oiled beaches. Sea otters and polar bears may be particularly vulnerable because they rely on fur to maintain body heat. Once oiled, sea otters (which also inhabit the Pacific Region) quickly become hypothermic, and both species may ingest oil while grooming, which may have lethal impacts on organs. Polar bears may also ingest oil while feeding upon oiled seals or scavenging oiled carcasses.

R.10 **COMMERCIAL & RECREATIONAL FISHERIES** may experience impacts from oil spills. Fish species and life stages residing in the upper water column are the most likely to contact spilled oil, particularly pelagic species and filter feeders that forage at the water's surface, such as menhaden. Depending on the location and duration of a spill, commercial fishing opportunities may be lost, and commercial fisheries revenue may temporarily decline. State or Federal agencies may close affected areas to fishing until the threat of contamination is over. Fishers moving to unaffected fishing grounds may experience additional costs, including increased competition and additional stress on targeted fish species. Larger spills may contaminate target species, causing potentially large-scale and long-term fishery closures, resulting in loss of revenue. Public perception of seafood quality and safety following a large spill may affect revenues far into the future. A minimum loss of $247 million was estimated from the fishery closures associated with the *Deepwater Horizon* oil spill (McCrea-Strub et al. 2011). Recreational fishing opportunities may be lost, and recreational anglers may turn to other forms of recreation.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES** may be impacted if oil or contaminated material reaches an archaeological site and alters its ecological, chemical, or physical status. Spills reaching areas closer to shore may affect shallow-water shipwrecks, historical or pre-contact period sites, and Traditional Cultural Properties.

If land or facilities are contaminated, closures or limits on use in areas such as beaches or ports may occur during clean up, and R.12 **LAND USE** may be impacted by spill response infrastructure such as staging areas, as well as transportation of workers and materials. Recovered oil and waste generated from the cleanup may impact capacity at waste disposal sites.

The R.13 **CULTURE** of coastal communities may be impacted by oil spills. Coastal communities form a collective social unity with livelihoods and cultural identity built around fishing; recreation and tourism; and a shared maritime history, economy, and traditions unique to their geographic area. Traditions of Native American and Alaska Native peoples depending on subsistence hunting and gathering of wild coastal and nearshore resources for food security (BOEM 2016d) may be impacted by oil spills. Bowhead whale hunting, for example, may be impacted by any spills or responses to spills in the vicinity, which may have deep and long-term impacts on the communities for whom hunting and sharing in the food is a cultural heritage. Food contamination is a particular concern for Alaska Native communities on the North Slope. Loss or contamination of food may diminish physical and mental well-being.

R.14 **VULNERABLE COASTAL COMMUNITIES** and populations may be disproportionately affected by a large spill, especially if impacted by cleanup operations or disruptions in social fabric and order. Historically marginalized communities have specific concerns related to their psychosocial welfare. Potential effects could include increased levels of depression, generalized anxiety disorder, post-traumatic stress disorder, and other psychological problems, which may result in intrapersonal consequences like violence and childhood trauma (Palinkas 2012). In addition, marginalized communities may be temporarily employed with oil spill cleanup, and there are potential human health risks associated with cleanup activities, such as decreased liver function due to exposure to oil (D'Andrea and Reddy 2014). These impacts could occur in any planning area impacted by oil spills. The food security of vulnerable coastal communities dependent on the harvest of wild food resources may be impacted by oil spills if spills affect the quality or availability of subsistence resources. Subsistence harvesters may also be impacted by increased costs associated with subsistence activities if they need to travel longer distances to access alternate harvest areas after an oil spill. These impacts on individual harvesters could result in community-wide impacts in subsistence communities that are dependent on the sharing of resources brought in by a small number of harvesters, as has been documented in some communities in the Gulf of Alaska and Cook Inlet (Keating et al. 2020).

R.15 **RECREATION & TOURISM** may be affected in areas impacted by oil spills. Ocean-based activities (such as beach visitation, watersports, or fishing) may be affected by a spill and subsequent cleanup efforts. Reduced tourism, due to either real or perceived impacts of a spill, may decrease earnings and impact coastal communities and states dependent on tourism-related income and revenue. Spills may reduce employment, income, and property values; increase public service costs; and cause shortages in commodities or services (Austin et al. 2014; Nadeau et al. 2014).